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STRONGER TONE

AND HIGHER QUOTATIONS IN PIG IRON MARKET.

Two New Blast Furnaces for a Steel Company.—Heavy Specifications on Sheet Contracts.

The market shows distinct signs of improvement this week. This is especially true of pig iron, as the demand for basic and Bessemer has continued strong, and that for foundry grades is much more active. The purchase of 15,000 tons of basic by a Schuylkill valley interest has taken about all of that grade available in that district. The Cambria Steel Co. has purchased 90,000 tons for delivery for the last half of the year, while the Republic Iron & Steel Co. has contracted for 17,000 tons from the Bessemer Association for third quarter delivery, and the association has disposed of 7,500 tons to other interests. There is a very heavy demand for foundry irons for prompt delivery, and stocks of such grades in furnace yards are very light. The price of northern iron is much firmer, the lowest quotation for No. 2 being $16.25, valley, although $16 can still be done in the Ironton district. In the south prices are also firmer on ordinary business, although some low quotations have been made on large inquiries. The announcement that two blast furnaces are to be erected at Indiana Harbor is further evidence of the increasing importance of the Chicago district as an iron manufacturing center. There are now eight blast furnaces in process of construction or contemplated in Chicago and vicinity.

Scarcity of Billets. Billets are scarce and the price for Bessemer is firm at $27 Pittsburg. The supply of sheet bars is not improved, and there will not be a general shutdown of plants this summer on account of the urgent demand for their products.

Rails and Track Supplies. Rail sales of the week include 26,000 tons to the Northern Pacific for 1907 delivery, and 8,000 tons to the B. & O. for 1906 delivery. The demand for track supplies for the present year is good, but contracts are not yet being made for 1907.

Sheets and Plates Active. The demand for sheets since the recent advance continues, and specifications are extremely heavy, those made to the leading interest having nearly approached the record during the last week. Specifications on plates are also coming in freely. Contracts for plates for two more lake vessels have been made.

Chicago's Demands. The strike of structural workers has checked building operations to some extent, but the demand for shapes for new buildings and bridges is strong. Chicago will require 25,000 tons for track elevation and the new plant at Gary, Ind., will take 50,000 tons.

Mills Filling With Orders. Last year the mills turning out merchant steel were filled with orders for the year in October, and it is expected that they will have all the business they can care for this year by about August 1. The price of cast iron pipe has been advanced $1 per ton.

Irregular. Wire Prices Business in wire products is active, but prices are not uniformly maintained, as independent interests show a disposition to make concessions. It will be necessary for a number of mills to suspend at an early date for repairs. Jobbers of wire nails and fencing are urging prompt shipment.

A dispatch from Berlin says that the technical university of that city has conferred upon George Westinghouse, the American inventor, the degree of Bachelor of Engineering.

DECREASED EARNINGS.

(Special Telegram.)

New York, June 13.—The statement of the Sloss-Sheffield Steel & Iron Co., for the quarter ending May 31, shows a decrease of net profits of $59,221, on account of continuation of labor troubles. The surplus shows a loss of $28,256.

At the annual meeting of the stockholders of the International Pump Co. the old board of directors was re-elected, except that Wm. Guggenheim will succeed H. K. Knapp and Irwin Stump will take the place of Jacob Rubine. The annual report was not submitted.

WILL ADD FURNACES.

The Inland Steel Co., Chicago, has acquired fifty acres of lake frontage at Indiana Harbor, Ind., on which it proposes to build two blast furnaces. This brings the total of blast furnaces under construction or projected in the Chicago district to eight, as follows: Federal Steel Co., one; Iroquois Furnace Co., two; Northwestern Iron Co., one; Illinois Steel Co., one at South Chicago; one at Joliet; Inland Steel Co. two.

Westinghouse Foundry Plans:—The Westinghouse foundry interests at Trafford City, Pa., near East Pittsburg, have acquired 20 acres in addition to their present plant and will greatly increase capacity, but no definite plans have as yet been made. It is not at all unlikely that some time in the future the foundries controlled by the company in Allegheny and Cleveland will be moved to Trafford City, where the electric machine and air brake constituent companies will be served. Charter for the Westinghouse Consolidated Foundries Co., has been applied for by Geo. C. Smith, Walter D. Updegraff and E. D. Seitz.

Wage Scale Conference.—The annual wage scale conference between the Republic Iron & Steel Co., and the Amalgamated Association is now on at Pittsburg, but at noon Wednesday no agreement had been made. The Amalgamated scale committee meets the officers of the American Sheet & Tin Plate Co. on Thursday of this week and representatives of the independent interest next Tuesday.

THE WEEK IN IRON CENTERS.

PITTSBURG.

Heavy Sales of Pig Iron.—Market For Finished Materials Strong.

OFFICE OF *The Iron Trade Review*
521 PARK BUILDING, June 13

A strong healthy market condition, with firm prices, heavy buying of pig iron and good contracts in finished lines and with every prospect for a continuation of these features has marked the week under review. The big feature of the week has been the purchase of Bessemer pig iron for third quarter and last half of the year, Cambria Steel Co., taking 90,000 tons for delivery over the latter period and the Republic Iron & Steel Co., taking an additional 17,000 tons for third quarter delivery. This latter purchase makes a total of 58,000 tons the Republic company has taken for June, July, August and September. Considerable basic pig iron has also been bought and northern foundry has improved a great deal during the past week, several sales being noted at $16.25, valley, and others at a higher figure. An investigation of conditions has brought out the fact that stocks of foundry iron at valley furnaces are very light, shipments being made almost as fast as the iron is produced. The strike of molders in this district has not as yet materialized, and this has probably helped the buying.

Several good sized contracts for new construction have been taken during the week, one company announcing new buildings requiring a total of nearly 6,000 tons of structural material. Building has been hampered by the striking structural workers. Specifications and new contracts for both plates and heavy shapes have been good and a decided improvement has been noticed in steel bars. The specifications on sheet and tin plate contracts have been almost up to the record breaking mark. The scarcity of semi-finished material, billets, and sheet and tin bars is as pronounced as ever.

Pig Iron.—Pig iron transactions have been more numerous and for larger tonnages during the past week than during any similar period for several months past. The largest transaction was a sale by W. P. Snyder & Co., to the Cambria Steel Co., of 90,000 tons of Bessemer pig iron for last half delivery. The price was not made public. The Bessemer Pig Iron Association sold 24,500 tons of Bessemer for third quarter delivery, about 17,000 tons of this going to the Republic Iron & Steel Co., and the remainder to other steel making concerns, outside of the Steel Corporation, which has not bought any pig iron for June, July or August. The major part of the association's sale was at $17.25, valley furnaces, but some of it, by manipulating freights brought as high as $17.40, valley. The Sharon Steel Hoop Co., bought 5,000 tons of Bessemer and 3,000 tons of basic, paying $17 for the basic and $17.25 for the Bessemer. The Allegheny Steel Co. bought 3,000 or 4,000 tons of basic pig. Reports that the Lackawanna Steel Co., Pennsylvania Steel Co., and other consumers have bought large tonnages in the valleys are not credited and are thought to have been started in New York without foundation on facts. There have been several small sales of Bessemer at fancy prices for prompt shipment and on this delivery $18 has been obtained. Another sale of 3,000 tons of basic was made at a shade under $17, valley.

Northern foundry iron has shown great improvement during the week and one sale of 1,500 tons was made at $16.25, valley, which is now the minimum for the Pittsburg district although lower quotations are made at other points. Considerable tonnage has been sold in small lots at $16.25 and in some instances $16.35 has been paid. One sale was made at $16.50, valley. Foundry stocks in furnace yards are reported as practically nothing, foundry iron being shipped as fast as made. Independent interests have experienced great trouble in securing Bessemer ores. We quote:

Bessemer Valley	$17.25 to 17.50
Bessemer, Pittsburg	18.10 to 18.35
No. 1 Foundry, Pittsburg	17.60 to 17.85
No. 2 Foundry, Pittsburg	17.10 to 17.35
Gray Forge, Pittsburg	16.35
Basic, Valley	17.00 to 17.25
Basic, Pittsburg	17.85 to 18.10

Ferro-Manganese.—There has been a considerable inquiry for ferro-manganese during the past week, more, in fact, than for some time past and for this reason the decline in prices which has been steady but gradual since March, has been temporarily stopped and we quote $75 to $80 for prompt delivery and $70 to $75 for July delivery.

Steel.—Bessemer billets have stiffened in price and at $27, Pittsburg, are exceedingly scarce and the three leading producers are out of the market on new business. Open hearth billets, on which market conditions are the same are quoted at $28, Pittsburg. The sheet bar situation has not improved and the supply is far below the actual requirements of the consumers. We quote $28 on sheet bars.

Skelp.—There has been no change in conditions and the demand for skelp as far as new business is concerned has been light although specifications against contracts have been fairly active. On narrow widths and light gauges we quote:

Bessemer grooved, 1.57½c to 1.60c; sheared, 1.65c to 1.70c; basic grooved, 1.60c to 1.65c; sheared, 1.65c to 1.70c; iron skelp, grooved, 1.65c to 1.70c; sheared, 1.80c to 1.85c.

Hoops and Bands. — Considerable new hoop business has been done during the week, and quite a tonnage has been booked. Specifications have been heavy. We quote unchanged, as follows:

Hoops, 1.90c in carload lots, and 2c on less than carload lots, bands, 1.50c base, half extras as per standard steel card. Prices f. o. b. Pittsburg.

Muck Bar.—There has been no inquiry and we quote $29 as a nominal price, based on the price of forge iron and the usual concession price.

Cotton Ties.—No new business has been placed and nothing is expected before July. The June price is 86c per bundle.

Rails and Track Material.—The leading interest during the week booked a contract for 26,000 tons of standard sections for the Northern Pacific, three-fourths of which is for 1907 delivery. The Illinois Central Electric Ry. ordered 1,320 tons, the Baltimore & Ohio 8,000 for this year's delivery and the Indianapolis, New Castle & Toledo Electric ordered 4,400 tons, of which 2,500 tons was for 1907 delivery. Further inquiry is good and the average is being maintained from week to week. The demand for light rails continues good. There has been a tremendous demand for railroad spikes, both iron and steel. We quote:

Fifty pounds and heavier, 500-ton lots and over, $28; carloads and less than 500 tons, $30; less than carload lots, $32; light rails, 16 pounds, $30; 20 pounds, $28.50; 25 to 45 pounds, $28.50; angle bars for standard sections, 1.50c; spikes, $2.05 to $2.10.

Sheets.—The latest advance in the price of sheets is too recent to have any pronounced effect on the market. The specifications against existing contracts made prior to the recent advance have been tremendous and in this respect the leading interest came within a few hundred tons of its high water mark last week. The inadequate supply of semi-finished steel is still seriously felt in the tonnage output and mills are further behind on their deliveries than they care to say. There

will be no general shut down during the summer, but every mill for which it is possible to obtain sheet bars will be operated through the summer months. Only mills where constant operation has made repair imperative, will be closed. There are no mill stocks and from what can be learned jobbers have none. We quote:

Black steel sheets, box annealed, cold, rolled, one pass: Nos. 11-12, 2.10c; Nos. 13-14, 2.15c; Nos. 15-16, 2.20c; Nos. 17-21, 2.25c; Nos. 22-24, 2.30c; Nos. 25-26, 2.35c; No. 27, 2.40c; No. 28, 2.50c; No. 29, 2.65c; No. 30, 2.75c. Galvanized, Nos. 10-11, 2.45c; Nos. 12-14, 2.55c; Nos. 15-16, 2.65c; Nos. 17-21 2.80c; Nos. 22-24, 2.95c; Nos. 25-26, 3.15c; No. 27, 3.35c; No. 28, 3.55c; No. 29, 3.80c; No. 30, 4.05c. Corrugated roofing, $1.75 per square for No. 28 painted, 2½-inch corrugation; $3.10 per square for No. 28 galvanized, 2½-inch corrugation. Quotations f. o. b. Pittsburg on large lots.

Tin Plate.—New business placed at the advanced price has been light, but specifications against old contracts have been very heavy and demand for deliveries has been urgent. Producers are far behind and without any new business it would take the mills at least two months to catch up with the order books of the leading interest while the independents have heavy contracts. The scarcity of semi-finished material is the great handicap and several mills are down on this account.

We quote: $3.75 per base box, f. o. b. Pittsburg, 14 x 20 100-pound cokes, terms 30 days, less two per cent off for cash in ten days.

Structural Material. — The demand for structural material continues despite the difficulty encountered in various parts of the country on account of the strike of structural workers who have hampered erection, in many instances by violence. During the week the McClintic-Marshall Construction Co. took a contract for a 3,000 ton job, another for 1,600 tons and a third for 1,100 tons, one being for the New York Central road, another for a car manufacturing plant and one each for a puddling mill and a manufacturing plant. On account of the labor troubles construction companies are withholding announcement of new contracts, although considerable business has been taken. A large amount of foreign work has been placed. Heavy shapes are in strong demand. We quote:

Beams and channels, 15 in., and under, 1.70c; over 15 in., 1.80c; zees, 1.70c; tees, 1.75c; angles from three to six inches, inclusive, 1.70c; over six inches, 1.80c; universal and sheared plates, 6¼ inches and wider, 1.60c base.

Merchant Bars.—There have been no new developments in the bar iron situation and prices have remained firm at the 1.50c base, and no foundation can be found for the report that bar iron has been offered in the Chicago territory at 1.45c or less, base Pittsburg. We quote:

Common iron bars, 1.55c, Pittsburg, in carload lots, 1.60c in less than carloads; for western shipment 1.50c base Pittsburg; Bessemer steel bars, 1.50c; plow and cultivator, 1.50c net; channels, angles, zees and tees, under three inches, 1.60c, all f. o. b. Pittsburg. The following differentials are maintained on steel: Less than 2,000 pounds, 0.10c advance; less than 1,000 pounds, of a size, 0.30c advance.

Merchant Steel.—There has been a decided improvement in steel bars and some good business has been booked by the mills at the association price. We quote:

Cold rolled and ground shafting, 50 per cent off in carload lots, and 45 off in less than carloads, delivered in base territory; tire steel, 1.70c to 1.80c; open-hearth spring steel, 2.25c to 2.50c; sleigh shoe flat, 1.50c to 1.55c; smooth finished machinery steel, 1.90c to 2c; toe calk, 2.05c to 2.10c. The price of planished and machine straightened tire is 1.70c base half extras as below. Iron finished tire up to 1½ inch by ½ inch, 1.65c base half extra tire list. Iron finished tire up to 1½ inch by ½ and over to be sold on regular bar basis of 1.50c base; half extra steel card.

Plates.—The improvement noted a week ago has continued, an immense amount of new plate business has been placed and specifications against existing contracts have been heavy. The big mills are maintaining prices firmly and paying no attention to the reports of a $2 shading by a small interest. The car companies are specifying very freely. We quote:

Tank plate ¼ inch thick, 6¼ to 100 inches, 1.60 f. o. b. mill, Pittsburg. Extras are as follows per 100 pounds, boiler and flange steel plates, 0.10c; A. B. M. A. and ordinary firebox steel plates, 0.20c; still bottom steel, 0.30c; marine steel, 0.40c; locomotive firebox steel, 0.50c; all sketches excepting straight taper plates, varying not more than four inches, in width at ends, narrowest end not being less than 30 inches, 0.10c; complete circles, 0.20c. Plates in width over 100 inches up to 110 inches, 0.05c; over 110 inches up to 115 inches, 0.10c; over 115 inches up to 120 inches, 0.15c; over 120 inches up to 125 inches, 0.25c; over 125 inches up to 130 inches, 0.50c; over 130 inches, 1.00c. Gauges under ¼ inch to and including 3-16 inch plates on thin edges, 0.10c; under 3-16 inch to and including No. 8, 0.15c; under No. 8 and including No. 9, 0.25c. Five cents extra for less than carloads. Terms net cash in 30 days.

Merchant Pipe. — Steel pipe is in good demand at the prevailing prices and considerable tonnage has been booked. The extreme discount in large lots is 81 per cent and 5 off. We quote the official discounts on pipe, consumers' carloads, with jobbers' carloads one point higher:

	Steel		Iron	
Consumer's Carloads	Black	Galv.	Black	Galv.
⅛ and ¼ inch	71	55	67½	51½
⅜ inch	73	59	69½	55½
½ inch	75	63	71½	59½
¾ to 6 inches	79	69	76	66
7 to 12 inches	74	59	71	55½
EXTRA STRONG PLAIN ENDS.				
⅛ to ⅜ inch	64	52	60½	48½
½ to 4 inches	71	59	67½	55½
4½ to 8 inches	67	55	63½	51½
Double extra strong plain ends, ⅛ to 8 inches	60	49	56½	45½

Boiler Tubes.—The demand for boiler tubes is seasonable, holding steady as it has for several months. Locomotive boiler tubes are still in very strong demand. We quote:

	Steel	Iron
1 to 1¼ inches	50	45
1¾ to 2¼ inches	62	45
2½ inches	64	50
2¾ to 3 inches	70	57
6 to 13 inches	62	45

Less than carload lots two points less.
2½ inches and smaller, over 18 feet, 10 per cent net extra.
2¾ inches and larger, over 22 feet, 10 per cent net extra.

Wire and Wire Nails.—It is now getting well along toward the time for the summer shut down for repair of mills, which will take at least a month. The demand is still good on specifications and prices have not changed. Mills are making their stocks to tide over July. We quote:

Wire nails, jobbers' carload lots, $1.85; retailers' carload lots, $1.90, and less than carload lots, $2; painted barb wire, $2 for jobbers in carloads; retailers in carloads, $2.05, and less than carloads, $2.15, with 30c for galvanizing, plain wire, $1.70 to jobbers and $1.75 by carload.

Old Material.—The recent purchase of rerolling rails and heavy melting scrap by the Steel Corporation caused a great flurry among dealers although the tonnage was much exaggerated. The total purchase did not exceed 7,000 tons. We quote, gross tons: Heavy melting stock, $15.50 to $16; No. 1 cast scrap, $15 to $15.50; cast borings, $8.50 to $9; bundled sheet scrap, $13.50; malleable scrap, $15.50; No. 1 railroad wrought, $17; low phosphorus scrap, $18 to $18.50; wrought turnings, $11 to $11.50; bushelling scrap, $14 to $14.50; iron axles, $25.50 to $26; old rails, rerollers, $17.50.

Coke.—Several good sized contracts running over the last half of the year

have been closed during the past week and several more are pending. There has been difficulty at some of the producing plants in securing a sufficient number of men and a curtailment of production is expected this week on account of the big Polish celebration which has been on for several days at Connellsville. A part of one of the largest operations in the district will soon be closed down on account of source of coal supply getting too far from the ovens. We quote strictly Connellsville furnace coke $2.35 to $2.45, ovens and foundry coke $2.60 to $2.75, although some higher prices have been secured. The estimated output for the week ending June 2 for the Connellsville region was 271,594 and for the lower Connellsville region 102,910 tons. The estimated production of coke in the Connellsville region during the current year to April 28, according to the U. S. geological report, amounted to 3,154,868 tons, against 4,423,724 for the corresponding period in 1905, and 4,742,953 in 1904. Of the 243,299 cars required to handle the 1906 movement, 32,052 were delivered to points east of Connellsville, 136,311 to points west of Pittsburg, and 74,936 to Pittsburg and the river. The total number of cars employed for like weeks in 1905 were 226,901, and in 1904, 165,048.

CHICAGO TO ELEVATE TRACKS.

Elevation of railroad tracks in South Chicago, to cost $4,000,000, is provided for in an ordinance recommended for passage by the Council Track Elevation Committee of Chicago. This elevation affects seven roads: Pittsburg, Fort Wayne & Chicago, 14.3 miles of track and 19 subways, $1,600,000; Lake Shore & Michigan Southern, 11 2-5 miles of track and 19 subways, $1,500,000; Baltimore & Ohio, 3 1-3 miles of track and 11 subways, $500,000; South Chicago railroad, 1.2 miles of track and four subways, $150,000; Chicago & Western Indiana, 15 miles of track and 11 subways, $600,000; Chicago, Rock Island & Pacific, 3.5 miles of track and 11 subways, $600,000; Chicago, Lake Shore & Eastern, $20,000. The elevation will start at Stony Island avenue and Seventy-ninth street and continue to the Indiana state line. The number of grade crossings to be eliminated by the ordinance will reach 90.

The governmental commission which has been investigating the question of revision of the Mexican mining laws, making coal and oil subject to the same general provisions as are other mineral deposits, has reported against any change and the matter has been dropped for the present.

CHICAGO.

Two Blast Furnaces to be Built.—Finished Material Market Active.

Office of *The Iron Trade Review*, }
1 62 Monadnock Block, June 14 }

The most important development in iron and steel news is the announcement that the Inland Steel Co., of this city, will build two blast furnaces at Indiana Harbor. Details are not ready for publication, other than that the company has acquired fifty acres of lake frontage adjoining its plant there as a site for this improvement. Activity in sales is most pronounced this week in finished materials. A large tonnage of structural shapes is being figured on here. Proposed track elevation work in Chicago will require 25,000 tons, and the plans completed for buildings at Gary involve 50,000 tons. New buildings closed by the American Bridge Co., including 900 tons for a machine shop and boiler house at Gary, amount to 3,000 tons. In addition, there are in various stages of negotiation building projects that will require another 50,000 tons and bridge construction for western roads that will amount to 5,000 tons. Specifications have been issued for the steel for two more boats to be built by the American Ship Building Co. for delivery in 1907. The company has ten boats under contract for next year, but the steel for five only has been bought, making a total of 25,000 tons. Competition is keen for the requirements of bedstead manufacturers, and low prices are being made to secure the hard steel tonnage of these interests. Pig iron is in better demand, but prices remain irregular. On the inquiry for a round tonnage from a large local consumer, a price considerably lower than $13.75 Birmingham for No. 2 foundry has been named by a southern furnace interest. Bar iron is without change in price, but is moving very slowly. A good movement is reported in steel bars on the basis of 1.50c, and mills are comfortably filled for the last half. Shafting manufacturers, however, decline to place annual contracts on the present basis, and their requirements, estimated at 100,000 tons, are being bought from month to month. In consequence, shafting is very strong and an advance in price is early expected.

Pig Iron.—Conservatism marks the buying of western foundrymen. Most of them are in need of tonnage for the last half, but the general run of orders still calls for prompt shipment. These are numerous enough to aggregate a round tonnage and to indicate the low stocks in foundry yards. Producers appear not uneasy over the outlook, although the despatch with which orders are filled is illuminative of the lean condition of furnace order books. The principal buying last week was of standard and malleable Bessemer, one melter taking 6,000 tons of the former at a price equivalent to $16.50 furnace. Northern foundry irons are in light demand, and the local product has declined to $18.25 Chicago for No. 2 foundry. Irregularity also exists in southern iron, as low as $13.25 Birmingham having been quoted on the requirements of a large local consumer by a producer capable of handling its entire tonnage. For small lots, however, the market remains firm at $14 Birmingham. Gray forge iron is stronger. The Sloss-Sheffield Co. has disposed of the stock of 20,000 tons which it had at Sheffield, and has since advanced its price to the basis of $12.50 Birmingham. The proposed construction of two blast furnaces by the Inland Steel Co. will have little effect on the local market, as the company contemplates using the entire output of same in its steel mills. There are now under construction, or projected in Chicago eight blast furnaces, without including the stacks to be built at Gary, Ind. We have revised our prices, and quote as follows:

Lake Superior charcoal	$19.00
Northern Foundry No 1	18.75
Northern Foundry No. 2	18.25
Northern Foundry No. 3	17.75
Northern Scotch Foundry	18.75
Ohio Strong Softeners No. 1	19.80 to 20.05
Ohio Strong Softeners No. 2	19.30 to 19.55
Southern Foundry No. 1	18.15 to 18.40
Southern Foundry No. 2	17.65 to 17.90
Southern Foundry No. 3	17.15 to 17.40
Southern Foundry No. 4	16.65 to 16.90
Southern No. 1 Soft	18.15 to 18.40
Southern No. 2 Soft	17.65 to 17.90
Southern Gray Forge	16.15 to 16.40
Southern Mottled	15.65 to 15.90
Southern Silveries (4 percent to 6 percent Silicon)	17.90 to 18.15
Jackson Co. Silveries, 8 to 10 percent Silicon	22.30 to 23.30
Alabama and Georgia Car Wheel	23.90 to 24.40
Malleable Bessemer	18.30 to 18.50
Standard Bessemer	19.30
Basic Iron	18.85

Rails and Track Supplies.—Little of importance has developed in the rail market this week. Interurban roads and small steam roads are busy placing orders for such deliveries as they can obtain, but the aggregate tonnage is not large. Light rails continue in excellent demand, the best delivery possible from western mills being October. Nineteen hundred and seven requirements in track supplies have not yet been placed, but there is a good demand for spikes and bolts for this year's delivery. Prices continue very firm and without change, as follows:

We quote, standard sections, f. o. b. mill, open-hearth rails, $29; Bessemer, $28; light rails, Bessemer steel, 30 to 45-pound sections, $27 to $28; 25-pound, $28 to $29; 20-pound, $29 to $30; 16-pound, $30 to $31; 12-pound, $31 to $32, and light sections down to 8-pound, $38 to $40, all f. o. b. mill. Track supplies are quoted as follows: angle bars, 1.50c to 1.75c; spikes (for quick shipment), 2.15c to 2.25c; (for forward deliveries) 2.05c to 2.10c; track bolts, 2.65c to 2.75c base square nuts.

Merchant Pipe.—New tonnage is abundant, and mills are getting behind in deliveries. Prices are very firm, and

since the advance in sheets considerable talk has sprung up of higher prices for pipe. This product has been low for some months, and in view of the high cost of raw materials, independent makers are especially anxious for higher prices. Mills continue to quote ¾ to 6-inch black steel pipe, 79.35 per cent discount from list Chicago, which is on the basis of 81 per cent Pittsburg. Galvanized pipe is quoted 69.35 per cent discount Chicago. Local jobbers are quoting 76½ to 77 per cent discount on the base sizes ¾ to 6-inch black steel pipe.

Cast Iron Pipe.—The only contract of importance closed in the week under review was with the city of Chicago for 2,000 tons, which is in addition to the tonnage it purchased a few weeks ago. A good volume of small business is coming forward, making in the aggregate a round tonnage. The strength of the pig iron market has resulted in an advance of $1 a ton in cast iron pipe. We have revised our prices, and quote carload lots, Chicago delivery as follows: Four-inch water pipe, $32; six and eight-inch pipe, $31, 10-inch and larger, $30; gas pipe, $1 extra.

Boiler Tubes.—There is a good movement in tubes, all consuming interests buying freely. Quotations are firmly maintained, and on account of the low prices prevailing, the possibilities of an advance at an early date are strong. The following discounts continue in force.

	Steel	Iron	Seamless
1 to 1¼ inches	46.35	43.35	53.35
1¼ to 2¼ inches	58.35	43.35	40.35
2¼ inches	60.35	48.35	43.35
2½ to 5 inches	68.35	55.35	
2¾ to 4½ inches (Seamless)			50.85
6 to 13 inches	58.35	43.35	

Less than carload lots, from store, as follows:

	Steel	Iron	Seamless Steel
1 to 1¼ inches inclusive	40	35	42½
1¼ to 2¼ inches, inclusive	50	35	35
2½ inches, inclusive	52½	35	30
2¾ to 5 inches, inclusive	60	47½	42½

Iron and Steel Bars.—The most noticeable feature of the trading last week was the heavy demand for steel bars. It is significant that the largest factors in this movement were the implement interests which were not allowed to participate in the buying when the price was reduced to 1.40c Pittsburg. Rumors are current that steel bars have sold at 1.45c Pittsburg within a very recent date, but in official quarters it is denied that any of the tonnage taken in the week under review was sold at less than 1.50c. Hard steel angles continue in good demand. From 1.70c to 1.80c, at which they were selling a few weeks ago, quotations have dropped to 1.45c to 1.50c Chicago, and at these prices the bedstead manufacturers have placed most of their business for the fiscal year ending June 1, next. Bar iron, while firm at 1.66½c Chicago, is experiencing a dull demand. Specifications are slow in coming forward, and a few mills in this territory are running to full capacity. We quote carload lots, mill shipments, Chicago delivery, as follows:

Soft steel bars and bands, 1.66½c, half extras; soft steel angles, less than 3 x 3, 1.76½c; hoops, 2.06½c base, full extras; old rail stock, 1.65½c. Jobbers report a good demand from stock, with prices firm. We quote bar iron, 2.10c full extras; soft steel rounds and squares, 3 inches and larger, $2 per 100 pounds base; flats, 2 inches to 4 inches by 1⅛-inch and larger, $2 per 100 pounds base; flats, 2 inches to 4 inches by 1⅛-inch and larger, $2 per 100 pounds base; flats, 4½ inches x 5 inches and 6 inches x 5-16 inch and thicker, $2 per 100 pounds base; all ovals, half rounds, $2 per 100 pounds base; steel bands, $1.85 to $1.95 half extras; soft steel hoops, $2.30 to $2.40 full extras. Other sizes not mentioned above, $1.85 per 100 pounds base, plus half extras.

Sheets.—The demand for sheets continues enormously heavy. The advance of $2 a ton in both black and galvanized announced last week has served to stiffen the inquiry rather than to diminish it. Mills are far behind in their deliveries, the leading producer being reported filled up for the balance of the year. Jobbers are experiencing some difficulty in getting shipments for the replenishment of their stocks, and warehouse prices are stiff in consequence. Local merchants have advanced box annealed black sheets and the entire galvanized list $2 a ton. We have revised our list, and quote mill shipments, Chicago delivery, as follows:

Nos. 8, 9 and 10, 1.96½c; Nos. 11 and 12, 2.01½c; Nos. 13 and 14, 2.06½c; Nos. 15 and 16, 2.16½c; box annealed: Nos. 18 and 20, 2.36½c; Nos. 22 and 24, 2.46½c; No. 26, 2.51½c; No. 27, 2.56½c; No. 28, 2.66½c; No. 29, 2.81½c; No. 30, 2.91½c. Jobbers' prices on less than carload lots from store are as follows: No. 10, 2.20c; No. 12, 2.25c; No. 14, 2.30c; No. 16, 2.40c; Nos. 18 and 20, 2.65c; Nos. 22 and 24, 2.70c; No. 26, 2.75c; No. 27, 2.80c; No. 28, 2.85c; No. 30, 3.30c.

Galvanized sheets, mill shipments, are as follows: Nos. 10 and 11, 2.56½c to 2.61½c; Nos. 17 and 21, 2.91½c to 2.96½c; Nos. 22 and 24, 3.06½c to 3.11½c; Nos. 25 and 26, 3.26½c to 3.31½c; No. 27, 3.46½c to 3.51½c; No. 28, 3.71½c to 3.76½c; No. 29, 3.91½c to 3.96½c; No. 30, 4.16½c to 4.21½c. From store, prices on less than carload lots are as follows: Nos. 10 to 20, 3.10c to 3.20c; Nos. 22 and 24, 3.25c to 3.35c; No. 26, 3.45c to 3.55c; No. 27, 3.65c to 3.75c; No. 28, 3.85c to 3.95c; No. 30, 5.05c to 5.15c.

Merchant Steel.—New tonnage continues of interesting proportions, and it is the expectation of manufacturers that they will be forced to withdraw from the market very early this year. In 1906, the leading mills were filled up about October, but this year they expect their entire capacity will have been taken about August. Specifications are very heavy and prices are firm. We quote mill shipments, Chicago delivery, as follows:

Spring steel, 2.10c; sleigh shoe, flat sizes, 1.71½c; concave and convex, 1.86½c; cutter shoe, 2.35c to 2.40c; smooth finished machinery steel, 1.91½c; smooth finished tire, 1.86½c base; plow steel, 2.20c and upward, according to quality; toe calk steel, 2.21c; railway spring, 1.86½c. Cold rolled shafting, 50 per cent off in carload lots and 45 per cent in less than carload lots. Crucible tool steel, 6½c to 8c; special grades of tool steel, 13c and up.

Plates.—Specifications and new tonnage for plates are improving. It is most noticeable in the demand for sheared material, the South Chicago mill being now comfortably filled for some weeks ahead. In addition to the specifications for the three boats to be built by the American Ship Building Co., as mentioned last week, the United States Steel Corporation has received specifications for the material for two more boats to be built by this interest at its Lorain yards, making a total of 25,000 tons. All these boats have been ordered for 1907 delivery and construction work on them will commence with the first shipments of steel. The ship building company has on its books orders for ten steamers for next year's delivery, nine being for bulk freight and one passenger. The material for the remaining five has not yet been ordered. Quotations are without change, as follows:

Tank steel, ¼-inch and heavier, up to 100 inches wide, 1.76½c base; flange steel, 1.86½c base; marine steel, 1.96½c base; all full extras. Plates 3-16 inch thick, $2 extra; gauges, 7 to 8, $3 extra; No. 9, $5 extra. Less than carload lots, $5 extra. We quote from local stocks; tank steel ¼ inch and heavier, up to 72 inches wide, 2c to 2.10c; 72 inches to 96 inches wide, 2.10c to 2.20c; 3-16 inch up to and including 60 inches wide, 2.10c to 2.20c; 3-16 inch 72 inches wide, 2.35c to 2.45c; No. 8, up to 60 inches wide, 2.15c to 2.25c; flange steel, 25c extra; heads, 25c extra.

Structural Steel.—It has been an active week in structural shapes. The American Bridge Co. has closed for the following buildings: Arcade, Seattle, Wash., 300 tons; Praetorium, Dallas, 350 tons; Franklin, Seattle, 200 tons; 68th street pumping station, and

South Park pumping station, both of Chicago, 250 tons; Illinois Central R. R. bridge material, 300 tons; Great Northern R. R., bridge material, 1,200 tons.

In addition, about 5,000 tons of bridge material is under negotiation with western roads. A large amount of structural steel will be required shortly in Chicago for track elevation work, an ordinance for about $4,000,000 of improvements of this kind having been recommended for passage by the Chicago city council track elevation committee. The western Indiana R. R. has already let a contract to the Kelly-Atkinson Co. for the elevation of its tracks in this city, the requirements of which will be in the neighborhood of 6,500 tons. Prices are without change, mill shipments, Chicago delivery, being as follows:

Beams and channels, 3 to 15 inches, inclusive, 1.86½c; angles, 3 to 6 inches, 1.86½c; angles, larger than 6 inches, on one or both legs, 1.96½c; beams, larger than 15 inches, 1.96½c; zees, 3 inches and over, 1.86½c; tees, 3 inches and over, 1.91½c, with the usual extras for cutting to exact lengths, punching, coping, bending, or other shop work.

Quotations on lots from store are as follows: All angles three inches and larger, including six inches, $2.25 per 100 pounds base; angles over six inches, $2.35 per 100 pounds base; tees, three inches and larger, $2.30 per 100 pounds base; beams, three inches to fifteen inches, inclusive, $2.25 per 100 pounds base; beams, eighteen inches and larger, $2.35 per 100 pounds base; channels, three inches and larger, $2.25 per 100 pounds base.

Wire Products.—Unusually strong conditions prevail in all wire materials. The tonnage under contract from the manufacturing trade is especially heavy, and it will be several months before mills are caught up with deliveries. Jobbers of wire nails and fencing are also clamoring eagerly for shipments, and so far, little, if any, stock has been accumulated for the fall trade. Anomalous though it may seem, it is a fact that while mills are literally overwhelmed with business, prices on agricultural products are not uniformly maintained. The cutting is almost conspicuous on wire nails, from 50 cents to $1 a ton being allowed from the schedule by some independent manufacturers and large jobbing interests. With this reservation, we quote local prices to jobbers, as follows:

Wire nails, $2; painted barbed wire, $2.15; galvanized barbed wire, $2.45; smooth annealed wire, $1.85; smooth galvanized wire, $2.15; polished staples, $2.15; galvanized staples, $2.40. Carload lots to retailers, 5 cents higher than above prices; less than carload lots, 15 cents higher.

Coke.—Conditions have not changed materially in the week under review. Spot coke is scarce, the local tracks being almost denuded of demurrage fuel. Contracting for forward deliveries shows a healthy increase and at prices considered good for this time of the year. We quote Connellsville 72-hour brands from $2.75 to $2.90 ovens, or $5.40 to $5.55 Chicago. Wise county coke is offered at $4.85 to $5 Chicago, and Solvay coke at $5.50 on contracts and $5.65 for immediate shipment.

Old Material.—The scrap market is still very dull. Very few large melters are in the market for any tonnage, and are only willing to consider purchases at concessions. The speculative fever still engages the principal dealers and a considerable amount of material is traded back and forth. Little of it, however, reaches the consumer and market values have not been strengthened by these transactions. The large purchase of heavy melting steel by eastern mills in the last week has sentimentally improved this product in the local market, but has not encouraged local consumers to add to their holdings. The only new list out this week is one of about 2,500 tons from the C. M. & St. P. Ry. We have revised our prices as follows, gross tons being given in the first paragraph.

Old Steel Rails (4 feet and over)	$16.00 to 16 50
Old Steel Rails (less than 4 feet)	14.50 to 15 00
Old Car Wheels	18.25 to 18.50
Old Iron Rails	21.00 to 21.50
Relaying Rails, subject to inspection	27.00 to 27 50
Heavy Melting Steel	13.00 to 13.50
Mixed Country Steel	11.50 to 12.00

We quote as follows net tons:

No. 1 R. R. Wrought	$13.50 to 14.00
No. 2 R. R. Wrought	12.50 to 13.00
Shafting	16.00 to 16 50
Dealers' Forge No. 1	11.50 to 12.00
Wrought Pipe and Flues	9.50 to 10.00
No. 1 Cast, 150 pounds and less	13.50 to 14.00
No. 1 Mill	8.50 to 9.00
Mixed Busheling (No. 1 & No. 2)	9.00 to 9.50
Country Sheet	7.50 to 8.00
No. 1 Boilers Cut	9.50 to 10.00
Boiler Punchings	11.50 to 12.00
Iron Car Axles	23.00 to 23.50
Steel Car Axles	18.00 to 18.50
Iron Axle Turnings	9.75 to 10.25
Cast Borings	7.50 to 8.00
Mixed Borings, etc.	7.50 to 8.00
Machine Shop Turnings	9.25 to 9.75
Railroad Malleable	13.00 to 13.50
Agricultural Malleable	12.50 to 13.00
Stove Plate and Light Cast Scrap	11.00 to 11.50
Old Iron Splice Bars	16.50 to 17.00

The Mark Mfg. Co., of Chicago, has abandoned its offices in the First National Bank building, the executive and sales departments being now located at the plant in Evanston, Ill., a suburb of Chicago.

The "Year Book" of the American Society of Refrigerating Engineers has just been issued. It contains a list of members, constitution and by-laws of the society. The society was organized in 1904 and already has a large membership. The president is W. Everett Parsons, of New York.

CLEVELAND.

Advance in Quotations of Northern Pig Iron.—Market Improves.

OFFICE OF *The Iron Trade Review*,
BROWNING BUILDING, June 12

Iron Ore.—The movement of ore on the lakes continues without interruption, though the car shortage on the range railroads has not been relieved to any great extent and upper lake dock facilities are still inadequate. Both these factors will have to be contended with throughout the season, as no general relief can be looked for. The volume of business is large enough to employ practically all the desirable freighters on the lakes, and is all that could be expected at this stage. No new sales of ore are reported, the entire tonnage for the season having been contracted for. Prices are nominal on the basis of $4.25 old range Bessemer.

Pig Iron.—The feature of the week has been a sudden and decided strengthening in foundry iron in northern Ohio. Inquiries on the basis of $16 valley are being turned down and $16.50 northern valley is apparently the new bottom figure, with $17 delivery the minimum for Cleveland. There is no spot iron to be had; one furnace interest during the week experienced great difficulty in securing a small tonnage to meet the immediate wants of its customers during the few days' shutdown. Practically the entire output of this district has been sold up to Aug. 1, and inquiries for fair tonnages are in good number. In Bessemer the situation is unchanged. Reliable estimates place the tonnage available during the third quarter at less than 30,000 tons. The corporation has postponed its buying until the last of the month, and from inquiries now pending little will remain at that time. A sale of 4,500 tons for third quarter delivery has been made by the Allegheny Steel Co. at $17.25 valley, and this figure will doubtless prevail for some time. A number of sales of basic are reported at $17 valley, in one instance for delivery into the last quarter. Coke prices continue unchanged at $2.65 to $2.75 for foundry grades, with one interest quoting $3. We quote, Cleveland delivery, as follows:

Bessemer	$18.10 to 18.35
No. 1 Foundry	17.25 to 17.50
No. 2 Foundry	17.00
No. 3 Foundry	16.50 to 16.75
No. 2 Southern	17.85 to 18.10
Gray Forge	16.35 to 16.85
Gray Forge Southern	15 85 to 16 25
Lake Superior charcoal	19.50 to 20.00

Finished Materials.—A good inquiry for standard rails is noted in this district and a sale of 1,500 tons to the Ann Arbor route for 1906 delivery has been made. The new schedule for sheets is being strictly adhered to,

though the immediate effect of the recent advance is apparent in fewer new contracts. Specifications continue good. Deliveries are not improved and an increased scarcity of sheet bars is anticipated because of the announcement that the Republic Iron & Steel Co. is to close its steel mill at Youngstown for three weeks during July. Forging billets for quick delivery are selling readily at $35 Cleveland. Considerable premium business is being done in structural shapes for immediate shipment. Plates are selling fairly well. The closing of contracts for three large lake freighters during the week will have the effect of bettering the situation in this line.

Old Materials.—Several railroad lists which have come out during the week have offered large tonnages; that of the Pennsylvania lines east containing more than 30,000 tons. Trading in this district is at a standstill and lower prices are anticipated before any advance sets in. We quote f. o. b. Cleveland, as follows:

Old iron rails	$20.00 to 21.00
Old steel rails (over 6 feet)	16.50 to 17.00
Old steel rails (under 6 feet)	16.00 to 16.50
Old car wheels	16.50 to 16.75
Steel boiler plate	12.00 to 13.00
Steel axles	19.00 to 20.00
Malleable iron (railroad)	15.00 to 15.50
Malleable iron (agricultural)	13.00 to 13.50
Heavy steel	14.50 to 15.00
Country mixed steel	13.00 to 13.50

We quote net tons, as follows:

No. 1 R. R. wrought	15.50 to 16.00
No. 1 busheling	12.00 to 12.50
No. 1 machine cast	13.50 to 14.00
Iron axles	22.00 to 23.00
Axle turnings	10.50 to 11.00
Wrought turnings (free from cast)	9.00 to 9.50
Grate bars	10.00 to 10.50
Pipes and flues	11.50 to 12.00
Tank iron	10.50 to 11.00
Hoop and band iron	7.50 to 8.00
Sheet iron	6.50 to 7.00
Wrought drillings	9.00 to 9.50
Stove plate	10.00 to 10.50
Cast borings	7.00 to 7.50

CINCINNATI.

Market Still Dull, But Prices Are Pretty Well Maintained.

June 12.

Pig Iron.—In this territory, the market continues exceedingly dull, but the dullness has had no apparent effect upon prices, with the exception of some reported concessions on malleable Bessemer. The only inquiry of importance comes from an Indiana concern and calls for 4,000 tons of foundry iron for delivery during the last half of the year. The feeling in the trade is that as we approach the first of July we are nearing the time when contracts will be worked out and melters will be forced to consider their future requirements. Buyers appear at this time to be indifferent and are apparently expecting to make contracts at lower prices than now prevail. On the other hand, furnace interests are making good shipments and find the iron taken quite readily with few requests to hold up on deliveries except in a few strike affected districts. This gives the furnace men confidence in continued requirements, and, as furnaces are not generally accumulating stock, prices are maintained. Some northern furnaces are advancing prices about 50 cents per ton, although in the Ironton district $16.00 at furnace is the ruling price for No. 2 foundry. It is believed in some quarters that, as soon as the new ore is melted and the increased cost is appreciated together with the fact that northern iron is relatively $1.00 per ton cheaper than southern on a competitive basis, northern makers will be inclined to put up prices. The increasing consumption of iron in the south has apparently had some effect in maintaining southern schedules and while some spot iron is being offered at liberal concessions, forward delivery southern iron is comparatively firm at $13.75 to $14.00 Birmingham basis. Virginia basic is quoted at $16.00 and valley basic at $17.00 to $17.25 at furnace. The following representative sales and inquiries show the important transactions in this territory.

Sales.

900 tons southern iron by analysis, June and July delivery, to an Ohio melter.

3,000 tons southern iron by analysis, in Chicago territory June, July and August delivery at an average price of about $13.50 for No. 2 foundry Birmingham.

2,000 tons valley basic, at $17.00 furnace.

450 tons Lake Superior charcoal.

500 tons Northern No. 2 foundry to an Ohio river point at $16.00 furnace, delivery over the balance of the year.

4,000 tons malleable in St. Louis territory, part of which sold at $16.00 Ohio furnace.

Inquiries.

4,000 tons are wanted in central Indiana for last half delivery, 2,000 tons of southern and 2,000 tons of northern iron.

An Illinois melter is in the market for 3,000 of malleable Bessemer, on which it is understood $15.75 Ohio furnace has been quoted.

We quote as follows, f. o. b. Cincinnati:

Southern Foundry No. 1	$17.25 to 17.50
Southern Foundry No. 2	16.75 to 17.00
Southern Foundry No. 3	16.25 to 16.50
Southern Foundry No. 4	15.75 to 16.00
Southern Foundry No. 1, soft	17.25 to 17.50
Southern Foundry No. 2, soft	16.75 to 17.00
Gray Forge	14.75 to 15.00
Northern Foundry No. 1	17.65 to 18.15
Northern Foundry No. 2	17.15 to 17.65
Northern Foundry No. 3	16.65 to 17.15
Jackson County Silvery, 3 per cent	21.15 to 21.65
Southern Charcoal	24.00 to 25.00

Finished Material. — The market remains moderately active at unchanged prices. There are some claims that bars can be bought below the schedule, but as a rule the Pittsburg basis prevails.

We quote: bars at 1.63c, half extras, with dealers quoting 1.85c for iron and steel out of store. Galvanized sheets, No. 10 and No. 12, in car lots are 2.68c. We quote black sheets, No. 27 at 2.40c in car lots of 500 bundles. Black sheets out of store are selling as follows: No. 28, 2.85c; No. 27, 2.75c; No. 16, 2.35c; No. 14, 2.25c; No. 12, 2.15c. Tank plates are firm and sell out of store at 2c to 2.10c for ¼-inch and 2.10c for 3-16, Nos. 8 and 10. Beams and channels are quoted at 2.25c to 2.35c from stock and angles at 2.10c to 2.15c for base sizes.

In merchant pipe, the market is steady with a fairly good demand with no quotable change in prices.

MERCHANT PIPE.
(Basing Discounts)

	Steel Pipe		Guaranteed Wrought Iron Pipe	
	Black Per cent	Galv. Per cent	Black Per cent	Galv. Per cent
⅛ and ¼ inches	69.7	58.7	....	....
⅜ inch	73.5	61 3	....	....
½ inch	73 7	61 7	....	....
¾ to 6 inches	77.7	67 7	....	....
7 to 12 inches	72.7	57.7	....	....

Coke.—As we approach the first of July contracts for foundry coke are expiring and consumers are considering the usual semi-annual purchases. Some of the foundries have come into the market and placed contracts. The supply is abundant in the Connellsville, West Virginia and Virginia fields and agents are generally eager for business. Prices in the leading coke producing districts are as follows:

Wise County, Va. Furnace Coke prompt shipment	$2.50 per ton
Wise County, Va. Foundry Coke on contracts	$2.65 to 2.75 per ton
Pocahontas Furnace Coke prompt shipment	$2.25 to 2.50 per ton
Pocahontas Foundry Coke on contracts	2.65 to 2.75 per ton
Connellsville Furnace Coke prompt shipment	2.50 per ton
Connellsville Foundry Coke on contracts	2.65 to 3.00 per ton
New River Foundry Coke on contracts	2.65 to 2.75 per ton
New River Furnace Coke, prompt shipment	2.50 per ton

†Wise County, Va., Coke on Furnace contracts is sold mainly on a sliding scale basis for pig iron prices on the following basis: $1.65 per ton on $9.00 pig iron, plus 17 per cent of the advance on pig iron above $9.00 Birmingham

Old Material.—The market rules dull and easy, but is not quotably changed. We quote f. o. b. Cincinnati:

Old No. 1 railroad wrought, net tons	$14.00 to 14.50
Cast machine and foundry, net tons	12.50 to 13.00
Old iron rails, gross tons	20.00 to 20.50
Old steel rails, gross tons	15.50 to 16.00
Old short lengths, gross tons	16.00 to 17.00
Old iron axles, net tons	22.00 to 23.00
Heavy melting scrap, gross ton	15.00 to 15.50
Stove plate, net tons	10.00 to 10.50
Wrought turnings, net tons	9.50 to 10.00
Cast borings, net tons	7.00 to 7.50
Car wheels, net tons	16.00 to 16.50

PHILADELPHIA.

Urgent Demand for Spot Iron.—Heavy Sales of Basic Pig.

June 12.

Pig Iron.—The most notable feature of the past week has been the insistent demand for spot iron, for June and

July delivery, which has pretty effectually cleared up everything in the market except some mill irons, for which there seems to be little demand. A large Schuylkill valley industry which got into operation only last year, has taken all the basic in sight, 15,000 tons, at prices ranging from $17.75 to $17.85, and swept the market so clean that no concessions in prices on this grade are likely to be made for some time. Another notable order was for 3,000 tons of low phosphorus at $25, which has also had a stimulating effect. Much interest is shown this week in the opening of bids by the city of Philadelphia for 23 miles of 48-inch pipe for its new filtration system. If this contract which is expected to aggregate not far from $2,000,000, is secured by local pipe founders, as it is believed it will be, it will necessarily mean large purchases in the near future. While foundry irons have been a little quiet, the number of inquiries has been large, and the volume of orders, mostly in comparatively small amounts, has been very considerable. Many buyers are asking furnaces to anticipate their orders, which shows how bare of stocks they must be. While it cannot be told that the expected heavy June buying has as yet set in, producers see nothing in the reduction that is discouraging. Some cautious consumers are reported to have placed orders for as far ahead as next March, but this is exceptional. Prices may be quoted as follows:

No 1X Foundry	$19 00 to 19 50
No. 2X Foundry	18.50 to 18 75
No. 2 Plain	18 25 to 18 50
Standard Gray Forge	16 25 to 16.50
Basic	17 75 to 18 00
Low Phosphorus	24.75 to 25.25

Finished Material.—A fair amount of new business is reported, especially in plates and structural material, but the productive capacity has now become so great that there is naturally some conjecture as to whether consumption will continue to keep pace with it. Except in bar iron, however, there are no signs of slacking, and prices remain unchanged as follows:

Beams, channels and angles according to specifications, 1.83½c to 2c; refined iron bars, 1.63½c to 1.73½c; steel bars, 1.63½c to 1.73½c; plates, 1.73½c to 1.83½c.

Old Material.—A few further concessions in price emphasize the weakness of the scrap market. Orders are scarce, and little activity is expected during the summer months. Prices, which still show a downward tendency, may be quoted as follows:

Southern No. 2X rail	18.75 to 19.00
Old steel rails	$16 25 to 16.50
No. 1 steel scrap	16.00 to 16 25
Old steel axles	19.00 to 19 50
Old iron axles	25.00 to 25.50
Old iron rails	20.00 to 20.50
Old car wheels	16.00 to 16.75
Choice scrap, R. R. No. 1 wrought	18.00 to 18.50
No. 1 yard scrap	16.00 to 16.75
Machinery scrap	15.50 to 16.00
Low phosphorus scrap	20.00 to 20.50
Wrought iron pipe	13.50 to 14.00
No. 1 forge fire scrap	13 50 to 14.00
No. 2 forge fire scrap, ordinary	9.75 to 10.25
Wrought turnings	12.50 to 13 00
Axle turnings, heavy	13.00 to 13.50
Cast borings	9 50 to 10.00
Stove plates	11.50 to 12.00

NEW YORK.

Pig Iron Buying Very Light.—Sales of Foundry Grades Less Than Consumption.

OFFICE OF *The Iron Trade Review*, ROOM 1315, No. 150 NASSAU ST., June 11

Pig Iron.—The week has developed no changes of note in the market. Sales are still small and the market for foundry and low grades is undoubtedly on the point of weakening, although favorite brands are bringing the prices established some months ago. Reports of great activity in steel irons in the central west and the Philadelphia district have stimulated hope in the local market also, and signs of an approaching crisis in the foundry iron market are not lacking.

The melt in the second half is expected to be fully as large as that of the first half of the year and stocks are running low. There is an immense prospective demand for metal which must be filled before long.

The most important transaction of the week was the purchase of 2,500 tons of various foundry grades by the Central Foundry Co. Other sales included 1,000 tons of gray forge, 600 tons of Virginia, and numerous small lots. There were reports of heavy sales of basic in the local market, more particularly one of 15,000 tons to the Eastern Steel Co. Inquiry is heavy for nearly all grades of iron, especially for basic and foundry.

Northern No. 1 Foundry	$18 25 to 19 00
No. 2 Foundry	17.75 to 18.55
No. 2 Plain	17 50 to 18.00
No. 1 Southern Foundry	18.00 to 18 50
No. 2 Southern Foundry	17.50 to 18 00
No. 3 Southern Foundry	16 75 to 17.20
No. 4 Foundry	16 50 to 17.00

Pig Iron Certificates.—Trading in certificates and standard foundry contracts on the New York Produce Exchange has been dull and featureless. Prices remain about the same and there were no sales. Very little iron is at present in the yards. The following are today's quotations for standard foundry contracts:

Standard Foundry Contracts.

	Bid.	Asked.
June	17.00	
July	17.00	
October	16.75	17.50

Finished Iron and Steel.—Thus far the week has yielded only light business in both rails and structural steel, but the next day or two may bring in enough orders to make more than the normal tonnage. Business under negotiation is very heavy, and important announcements may be made any day. A number of small orders for rails, totaling some 10,000 tons, made their appearance during the last three days. The largest order for structural material for the same period is for a machine shop for the steel plant at Gary, Ind., requiring 900 tons of material. Plans for the other buildings of the great plant are also rapidly nearing completion, and the contract for supplying the shapes for the rail mill, about 10,000 tons, will be arranged within the near future. The bulk of the work will be contracted for later, the orders for some buildings being probably postponed for a year or more. The inquiries for rails from Canada and Japan and for bridge material from Japan reported last week have not yet resulted in actual business. The plate market is quiet and is not expected to show great activity within the next few weeks. The Lukens Iron Co. has been awarded the contract for supplying 200 tons of plate required to repair the Fall River line steamship recently burned to the water line. The market for bar iron is lacking in vitality and prices are ragged.

The following are prices at tidewater: Angles, 3 to 6 inches x ¼ inch and heavier, 1.84½c; beams, 3 to 15 inches, 1.84½c; tees, 3 x ¼ inch and heavier, 1.89½c; plates, carloads, tank, 1.74½c; flange, 1.84½c; marine boiler, 2.41½c; refined iron bars, 1.64½c; soft steel bars, 1.64½c; sheets, No. 28 black, 2.40c.

Old Materials.—The market is very quiet and prices are weak without any apparent change in values. There is a lack of interest among buyers and very little stock is being forced. Several lots of 100 and 200 tons each of heavy melting steel scrap were reported sold during the week, mostly to be delivered at a mill in eastern Pennsylvania. There was also a sale of about 500 tons of wrought railroad scrap, and purchases of heavy cast scrap amounting to more than 1,000 tons. The following are prices approximately f. o. b. tidewater:

Old iron rails	$21.00 to 22 00
Old steel rails, long lengths	15.00 to 15.50
Old steel rails, short pieces	14.50 to 14.75
Relaying rails	24 00 to 25.00
Old car wheels	17.00 to 18 00
Old iron car axles	26.00 to 27.00
Old steel car axles	19 00 to 19 50
Heavy melting steel scrap	15.00 to 15 50
No. 1 railroad wrought scrap	17.50 to 18 50
Iron track scrap	16 50 to 17.00
Wrought pipe	12.50 to 13 50
Cast borings	9 50 to 10.00
Wrought turnings	13.00 to 13.50

ST. LOUIS.

Market Dull, But Believed that Bottom Prices Have Been Reached.

June 11.

While the market continues somewhat dull, a belief prevails among the iron men that prices have touched bottom and that a buying movement is sure to begin in the next few weeks. They point to the fact that there has

been no abatement in the almost unprecedented consumption of iron and the melters are running low on their reserve stocks. The founders are beginning to realize, too, that there is little accumulation of iron in the bins of the southern furnaces to help bear down the price, which seems inclined to settle down upon the basis of $13.50 to $13.75 at the furnace. It is true that Birmingham iron continues to sell at $14, but it is bought chiefly by those melters who have it definitely placed in their mixtures and refuse to substitute other brands.

Orders are generally of the carload lot with some ranging as high as 300 tons, indicating a hand to mouth market. As soon as it is definitely established that iron will go no lower, there will be no dearth of buying. The matter of price is the only question now. The order of the St. Louis Malleable Castings Co., for 3,000 tons of malleable Bessemer and 1,000 tons of southern gray was placed last week, but at such a price that the houses making the sale refuse to confirm it. It is understood that the sale was divided between two houses, the foundry order being placed somewhere between $13.25 and $13.40. There were several houses in a scramble for the order, which is the largest which has appeared in this market lately, and it is known that at least two of them went under $13.50.

One hundred tons of southern No. 2 was sold during the week to Moline interests at $13.75. Two hundred tons of No. 4 went to Central Illinois interests at $12.50. One hundred tons of Virginia foundry went to the same melter.

Iron quotations, including the freight rate of $3.50 on Birmingham basis, range as follows:

Southern No. 1	$17.50 to 18.00
Southern No. 2	17.00 to 16.75
Southern No. 3	16.50 to 17.00
Southern No. 4	16.25 to 17.75
Gray Forge	16.00 to 16.50

Finished Material.—Negotiations are still in progress looking to a settlement of the structural iron and steel workers' strike, but no progress has been made. On the contrary, the building situation is tied up worse than ever as the Building Trades Council has declared its contract with the contractors broken and has called off all the bricklayers and stonemasons in the city. There is a complete tie-up in building operations which may seriously threaten the building movement. No large contracts for fabricating work were let here in the last week, though it is reported that Brown-Ketcham obtained the contract for the 6,500 tons of steel for the Maison Blanche department store at New Orleans.

Metal Market

NEW YORK.

June 11.

Pig Tin.—Although the market has recovered from its condition of extreme demoralization the tendency is lower and easier. The following are today's quotations: Spot, 39.70 to 40.00, June, 39.50 to 39.75; July, 39.25 to 39.50; August, 39.05 to 39.25; London: £181 12s 6d and £181. Arrivals for the month to date, 875 tons; afloat, 3,140 tons.

Copper.—In spite of a report of an estimated gain in production of 20 per cent since January, the market remains unchanged.

Today's quotations: Lake, 18¾c to 18⅞c; electrolytic, 18⅜c to 18⅝c; casting, 18¼c to 18⅜c. London: £86 2s 6d and £84 17s 6d. Exports for the month to date, 5,236 tons.

Lead.—There has been a better demand and the market remains steady. Today's closings, 5.90 to 5.95; St. Louis, 5.90. London, £17.

Spelter.—With a more active demand the market has developed a firmer tone. Today's quotations: 6 to 6.10c. St. Louis, 5.92½. London, £17 15s.

Antimony.—The market is dull and nominal. Today's quotations follow: Cookson's and Hallett's, 26 to 27c; other grades, 25½ to 26½c.

CHICAGO.

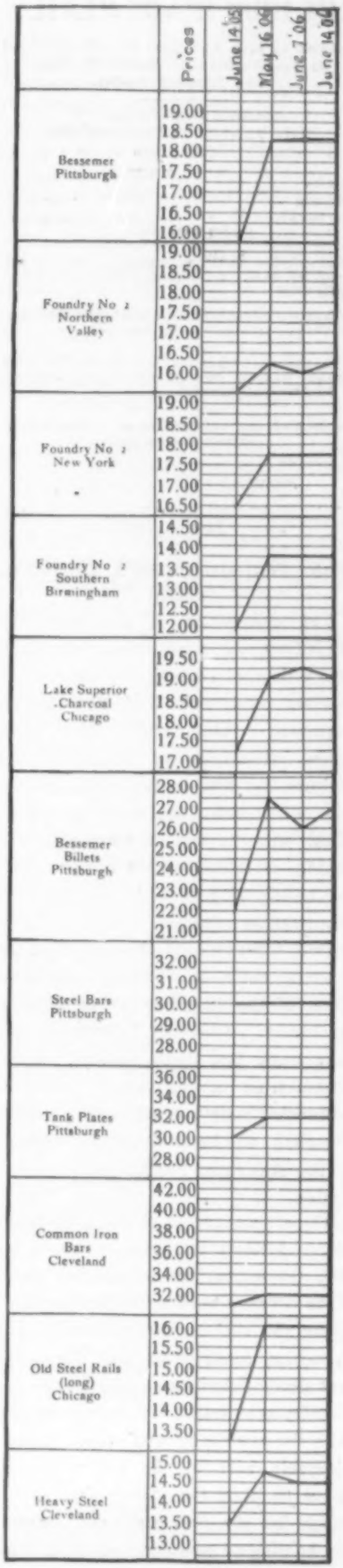
June 12.

The softness in spelter and tin is the more conspicuous because of the remarkable strength of all other metals. Spelter is quoted at 6.15c to 6.25c for car lots, and pig tin at 40c to 41c, according to quantities. Copper is very firm and premiums are being paid for prompt deliveries. Lake is quoted at 18¾c to 19¼c and casting at 18½c to 18¾c. Less than car lots are ¼c to ¼c higher. Sheet zinc is in fair demand at $7.65 f. o. b. La Salle in car lots of 60-lb. casks. Lead, desilverized, is firm at 6.15c to 6.25c for 50-ton lots; corroding, same quantities, 6.65c to 6.75c. Antimony, from 30c to 33c, according to quality.

Dealers in old metals are well stocked with material, and prices are not so firmly maintained as on the new product. The demand is light, and to accomplish sales concessions are required. We quote dealers' buying prices, as follows: Copper wire, 16¼c; heavy copper, 16c; copper bottoms, 15c; copper clips, 15½c; red brass, 15¼c; yellow brass, heavy, 12c; yellow brass borings, 10c; red brass borings, 13½c; light brass, 8½c; pipe lead, 4½c; tea lead, 4½; zinc, 4¼c; tin foil, 31c; pewter, No. 1, 23c.

After an idleness of one and one-half years the sheet and tin-plate departments of the Whitaker-Gloessner Co., at Wheeling, have started up.

PRICE CHART.



THE IRON TRADE REVIEW

Devoted to Iron and Steel Manufacture and to the Machinery, Metal-Working and Foundry Trades.

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June 14, 1906

THE FOUNDRYMEN'S CONVENTION.

The convention of the American Foundrymen's Association last week was a decided success, not only in the number and value of the papers presented and in the very large attendance of members and visitors, but also in the extensive display of foundry appliances and supplies. As the use of machinery has rapidly increased within a few years, the opportunity to make a display of labor-saving devices has been presented, but not until this year was an attempt made to illustrate the progress of the manufacturer of foundry machinery. The very impressive display made last week resulted in the organization of the American Foundrymen's Supply Association which promises to be an important adjunct of the American Foundrymen's Association.

The entertainment of the large number of visitors and members who attend the annual conventions has come to be a heavy burden, not only in outlining the various entertainments, but in raising funds necessary. Hence, it was decided that those who sell to the foundrymen ought to be connected with the association and provide a considerable part of the entertainment, so as to leave the officers free to arrange for the presentation of papers, the holding of meetings and other features directly connected with the association work. It has been notorious that at conventions some who come representing their business interests and derive much benefit contribute little or nothing toward the expense. The new plan provides for a more equitable division of expenses, and excellent results will no doubt be seen at the Philadelphia convention.

The association was exceedingly fortunate in its choice of president and other officers for the ensuing year which promises to be one of the most prosperous in its history. An unusual evidence of the value of the association's work at home and abroad has been furnished during the past year, and the new administration will add much to the splendid record already made.

THE SPREAD BETWEEN FOUNDRY AND STEEL MAKING PIG IRON.

A very remarkable change has come over the pig iron market in the central west as regards the relation of steel making pig iron to other grades. From the latter part of last November until the present time, Bessemer pig iron has been about $17.25 at furnace. At the beginning of the period this price might possibly have been shaded 25 cents, while at times 25 cents more has been obtainable. During practically all this time basic pig has been at the same price as Bessemer, or not more than 25 cents less. Until some time in March, No. 2 foundry pig remained steadily at either the same price as Bessemer, or not more than 25 cents below it. In March the shading of two producers of foundry iron became very pronounced in certain districts and later foundry iron became definitely established at a lower price than Bessemer at all points in the central west where both are produced. These two grades have been lifelong friends, and predictions were freely made a few weeks ago that foundry iron would either work up or Bessemer would drop, until a substantial parity was reached.

During the past four weeks the disparity between foundry and steel making pig, instead of disappearing, became even more pronounced. Quotations of $16.00 at furnace were freely made on No. 2 where the prospective order was particularly attractive, while Bessemer pig has been very firm at the old price of $17.25 and has manifested a distinct advancing tendency, there being more prospective buyers than sellers, and one lot of 200 tons, for June delivery, having sold recently at $17.75. Basic has been very firm at $17.00, and producers have themselves sounded the market, presumably because they were scarcely able to make their obligated shipments.

The present strikes of molders and coremakers in various districts cannot be held responsible for much influence on the market for long time deliveries of foundry iron, as they are of too ephemeral a nature. They have, of course, reduced the premiums demanded for small prompt lots of iron. The market seems to have been definitely settled at a spread of a dollar or more between foundry and steel making pig, which is contrary to all established precedents, while the demand for foundry iron is relatively light, and the demand for steel making pig, as judged by the known prospective requirements of four or five large steel interests, is very heavy.

The cause of this severing of relations between two old friends is to be found in the scarcity of Bessemer ores, the scarcity of chill casting apparatus and the demand for steel making pig.

It is the testimony of all the large merchant ore firms that the available Bessemer ores for this season's delivery are practically all sold, that there is no old range Bessemer at all, and but limited quantities of Mesabi Bessemers, and those of an inferior grade. This testimony is fully confirmed by the experience of several merchant furnace interests, which have lately sounded the ore market with a view of buying Bessemer ores for this season and changing their schedules to make more Bessemer pig and less of other grades than they had intended when making their original purchases before the opening of the shipping season. The only recent transaction of importance in Bessemer ore was the case of an ore interest which was

buying Bessemer pig from a merchant furnace interest, and was compelled to sell the ore in order to get the pig iron. It is established that the merchant furnace interests can this year make only the amount of Bessemer pig iron which they originally contemplated making.

The scarcity of basic pig is due to the limited facilities for chill cast pig. While in times of stress analyses may not be scrutinized so closely, the absence of sand is essential. More than half a dozen years ago, an active campaign was instituted by the makers of pig casting machinery for the introduction of their apparatus, and the education of foundrymen to put them in a frame of mind whereby they would not only accept, but would request, deliveries of chill cast pig. That campaign seems not to have been very successful, inasmuch as the demand for basic pig in the central west appears to absorb the chill casting capacity which is available.

In the Shenango valley but one merchant interest, which owns four furnaces, can make a basic pig. There are six other merchant furnaces in the valley, all of which make Bessemer, but none makes basic. In the Mahoning valley three merchant furnaces are equipped with chill casting apparatus and another can cast in chills, without the conveying apparatus. There remain five merchant furnaces in the valley which do not cast in chills and all but one of these make Bessemer at times.

In other districts in Ohio, and in western Pennsylvania, the facilities for chill casting are equally limited. The newer merchant furnaces in this whole region were projected at a time when the future of a merchant furnace did not appear very bright as to steel-making pig, while the foundry field appeared to be one which could easily be entered. At the same time it was much easier to provide a supply of ores for making foundry and forge iron than for making Bessemer.

The demand for steel making pig has greatly increased from the steel casting industry, which has grown very rapidly by the entrance of new producers and larger operations on the part of older producers. This demand is both for Bessemer for the acid open-hearth furnace and for basic for the basic open-hearth furnace. The requirements of outside iron by the regular producers of rolled Bessemer and basic steel, instead of diminishing through added blast furnace capacity, have increased through the great increase in steel production. The United States Steel Corporation has been a steady buyer, absorbing from time to time all the surplus Bessemer in the market. The fear that it may not be able to obtain all the outside pig iron it may need in the next few months, and may be forced to buy heavy melting scrap, something it does not seem to have done for more than two years in the Pittsburg market, has in the past few weeks deterred some scrap dealers from making the customary short sales to other consumers, although otherwise the scrap market has been distinctly weak in tone. Such purchases are not regarded by these dealers as a probability; the bare possibility, with its consequent powerful effect on the scrap market, being sufficient to deter them.

Several other large steel producers have been large purchasers of Bessemer pig iron to July 1 and August 1, but, except in a few instances, they have not made important purchases for later delivery, although their requirements promise to be undiminished. There is in addition the certainty that the new Bessemer steel plant at Youngstown will be completed some time this year, and when it is, the obvious result will be the practical disappearance of the furnace association as a seller of steel making pig, as the furnaces composing it are largely interested in supplying this new plant with pig iron. The date originally set for the completion of this plant is only a short time off, and while the first expectations will not be realized, the delay will not amount to more than a very few months.

At this time it can safely be said that all the indications point in the same direction, to a continuance of wide spread between foundry and steel making pig in the central west, through the present year at least, and perhaps for a much longer time.

WILL EXPLOIT CRANK MECHANISM.

A new corporation, known as the Ramsey Engine Co., with offices in the Bullitt building, Philadelphia, has been formed for the purpose of exploiting the Ramsey crank mechanism, a device applicable to all single-acting engines. A number of advantages are claimed for this device, and it is stated that in a series of tests made under the supervision of the University of Pennsylvania on a vertical engine having a nine-inch cylinder and seven-inch crank a total efficiency of 25.9 per cent was obtained, which is very extraordinary for an engine of such dimensions. The officers of the Ramsey Engine Co. are: President, Robert H. Ramsey, who is the inventor of the Ramsey crank mechanism; vice president and general manager, Russell H. Ramsey; secretary and treasurer, R. Howard Eisenbrey. Russell H. Ramsey and Mr. Eisenbrey were formerly connected with the Harrison Safety Boiler Works, of Philadelphia. It is understood that the new company will not manufacture engines, but that it will issue license rights to engine manufacturers.

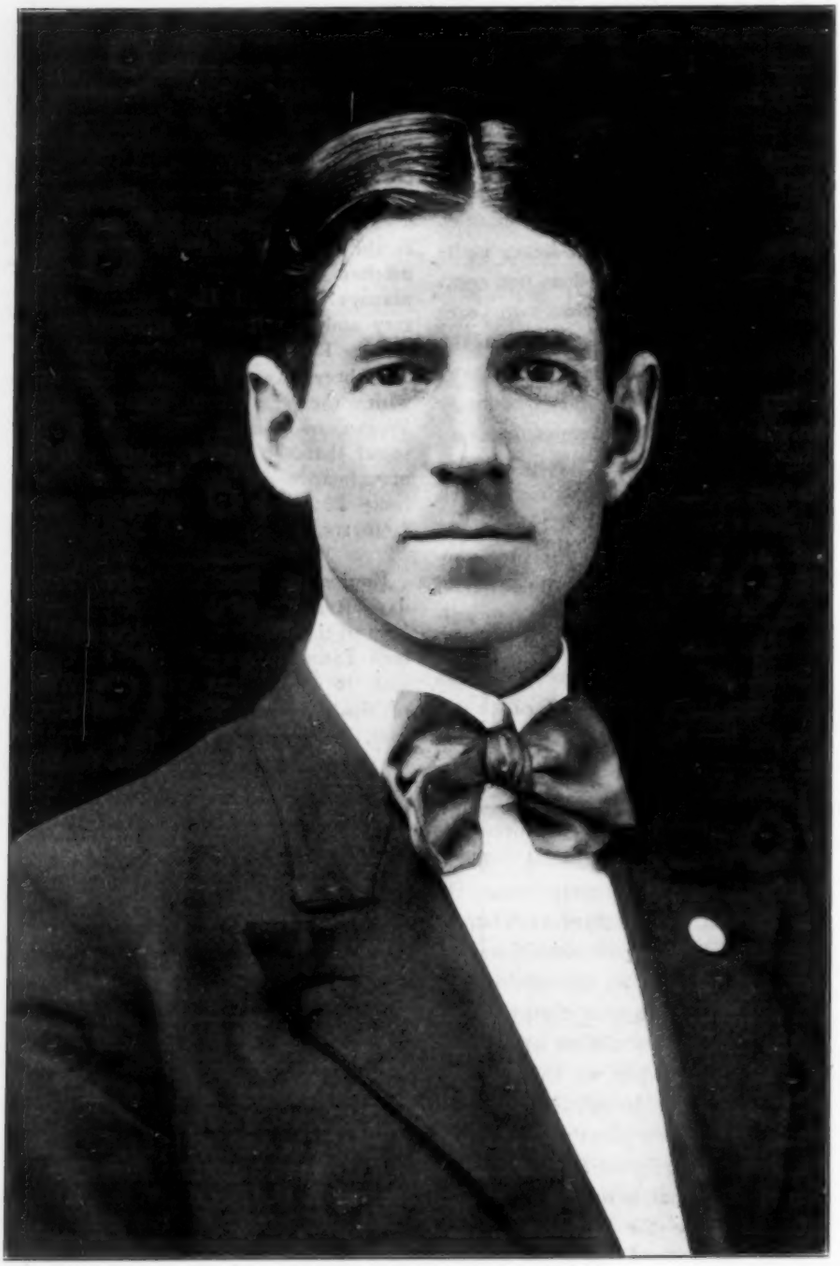
Engineers' Excursion.—On Saturday afternoon of this week the members of the Engineers' Society of Western Pennsylvania will take an excursion to the Edgar Thomson Works of the Carnegie Steel Co., at Bessemer, Pa. Special objects of interest are two 1,500 horsepower motors, the largest ever built, for driving a rail mill; the largest Bessemer converting plant in the world; a 350-horsepower experimental gas-driven blowing engine; foundation for the gas driven blowing engine with capacity of 20,000 cubic feet of free air per minute, and the concrete retaining walls for the ore yard, 30 ft. high and 1,300 ft. long.

New Ore Cargo Record. — The steamer J. Pierpont Morgan June 12 loaded 13,294 gross tons of ore at Escanaba and smashed all cargo records. The cargo will be delivered at South Chicago, and she carried 956 tons more than the steamer E. H. Gary did when she made the record between the two ports. The Gary holds the record from Lake Superior. She carried 11,093 tons through the Soo river. The Morgan will probably be sent to Lake Superior on her next trip, when a new record for that trade will be made.

The foundry building of the Latrobe Foundry & Machine Co., Latrobe, Pa., of which John F. Gilligan is owner, burned with contents June 12, with a loss of $10,000.

W. H. McFADDEN, PRESIDENT OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION.

W. H. McFadden, newly elected president of the American Foundrymen's Association, is one of the best known and most popular manufacturers in the country. He is vice president and general manager of Mackintosh, Hemphill & Co., of Pittsburg, and his entire career in the iron and steel business has been in connection with this company.



W. H. McFADDEN.

Mr. McFadden is a self-made man, who, by native ability and steady application, advanced himself from machinist apprentice to general manager of one of the largest concerns of its kind in the country. For many years he has been actively identified with the National Founders' Association as chairman of the third district and has served on its administrative council and assisted in this capacity in concluding successfully many of its most important conferences between that association and the molders' union. He was also president of the Pittsburg Manufacturers' Association in 1905 and president of the Pittsburg Foundrymen's Association the same year. Under Mr. McFadden's supervision, machinery for the following plants was built and erected: Ashland Steel Co., Bellaire Steel Co., Benwood Steel Works, Bethlehem Steel Co., Colorado Fuel & Iron Co., Duquesne Steel Works, Edgar Thomson Steel Works, Jefferson Iron Works, Hainsworth Steel Co., Homestead Steel Works, Jones & Laughlin Steel Co., Junction Steel & Iron Co., Joliet Steel Works, King, Gilbert & Warner Co., Troy Steel Co., Lackawanna Steel Co., Maryland Steel Co., National Tube Co., and its different plants, Passaic Rolling Mill Co., Phoenix Iron Co., Eastern Steel Co., Park Brothers & Co., Portsmouth Steel Co., Riverside Iron Works, Roane Iron Co., Spang, Chalfant & Co., Schoenberger Steel Co., Shenango Valley Steel Co., Cambria Steel Co., Dominion Iron & Steel Co., Worcester Steel Works, New York State Steel Co., Youngstown Sheet & Tube Co. and Millikin Bros.

In April, 1888, Mr. McFadden started as a general apprentice in the machine shop and drawing room of Mackintosh, Hemphill & Co., Ltd., and served time in the foundry and pattern shop. Eager to master his chosen profession, Mr. McFadden, by over time and Sunday work, served one year and five months additional apprenticeship, or during his three years' term by this means served four years and five months. In 1891, before he had finished his apprenticeship, Mr. McFadden was sent by his company to superintend the construction of the Ashland Steel Co.'s plant at Ashland, Ky., and in 1892, returned and finished his time in the shops.

In 1893, he was made foreman of the open-hearth steel department of Mackintosh, Hemphill & Co., Ltd., and held this position one year, when, in 1894, he was made general superintendent of the whole plant. In 1895, while acting as superintendent of the plant, he assumed the additional duties of superintending the building of the Star tin plate plant, including both buildings and machinery. In 1896, Mr. McFadden was made assistant manager of Mackintosh, Hemphill & Co., and held this position until 1902, when, under the partial reorganization of the company, and the retirement of Mr. Hemphill, he was made vice president and general manager, which position he still holds.

Mr. McFadden is a tireless worker and in connection with his election as president of the American Foundrymen's Association, he said he is going to put forth every effort to make this year the greatest in the history of the organization.

In exports to Japan, during the fiscal year 1905, manufactures of iron and steel, aggregating about $10,000,000, were second only to raw cotton.

AMERICAN FOUNDRYMEN'S SUPPLY ASSOCIATION.

In January, 1906, a group of foundry supply dealers in Cleveland met to discuss the advisability of holding an exhibition of foundry supplies and equipment in connection with the American Foundrymen's Association convention in Cleveland, June 5-7. This resulted in the formation of what was known as the A. F. A. Exhibit Association, a local organization formed to conduct the exhibition in Cleveland.

J. S. Smith, of the J. D. Smith Foundry Supply Co., was elected president, and H. M. Lane, editor of THE FOUNDRY, secretary and treasurer. To provide funds for carrying out the preliminary work and to insure the work of the exhibit, the 11 members of the original association each contributed toward a guarantee fund which was paid in at once. Several meetings were held, the matter discussed thoroughly, and it was decided to rent the Central Armory, which is 120 x 207 feet, and to hold the exhibit and the convention in the same building. Letters were sent to all supply dealers throughout the country, and a large number responded heartily.

The exhibit, as carried out by the A. F. A. Exhibit Association proved very successful indeed, and on the second day of the exhibit, June 6, some of the exhibitors, together with a few supply men, held a meeting at the armory to consider the advisability of a permanent foundry supply association for the purpose of financing the entertainment features of the annual conventions, and also for the purpose of carrying on an exhibit of foundry supplies and equipment each year in connection with the convention. The exhibit has proven to be such a drawing card at Cleveland that an unanimous opinion was expressed in favor of such an association. H. M. Lane was chosen temporary chairman, and first gave a statement of the history of the Cleveland exhibit. The organization committee was then appointed to nominate officers and outline the business of the organization. This committee consisted of C. T. Smith, of the Chicago Pneumatic Tool Co., Cleveland, O., S. T. Johnson, of the Obermayer Co., Chicago, Ill., U. E. Kanavel, of the Interstate Sand Co., Cleveland, O., P. C. White, of the White Tool Supply Co., of Cleveland, and S. W. Hubbard, of Rogers, Brown & Co., Cleveland.

Some of the advantages to be derived from such an organization, as brought out in the discussion, were as follows:

The holding of an exhibit in connection with the convention would serve as a drawing card and make the conventions much more popular.

The fact that the supply men would look after the financing of all the entertainment features of the convention would relieve the A. F. A. officers of such work and leave them free to carry on the regular work for which the association was formed, namely: the advancement of foundry practice by the reading and discussion of papers; in other words, the promulgation of foundry literature and the education of foundrymen.

The forming of a regular supply association similar to the Master Mechanics, Master Blacksmiths and Master Car Builders, etc., would place all of the supply men on an equal footing, so that the expenses would be divided more equitably than has been heretofore possible.

Every convention has had marked examples of the means by which some people "sponge" on their more generous competitors.

By building up both associations, making the membership in each desirable and making the entertainment features exclusively for members, many of these abuses would be avoided.

On the return trip of the members and guests of the association from Lorain the following day, a meeting of all the supply men on board the boat was called to order in the cabin of the vessel. Mr. Lane was made temporary chairman of the meeting, and briefly explained the business of the proposed association as outlined above for the benefit of those who were not at the preliminary meeting. He then reported that the organization committee had nominated the following officers for the association: President, S. T. Johnson, Obermayer Co., Chicago; first vice president, E. H. Mumford, E. H. Mumford Co., Philadelphia; second vice president, E. A. Kebler, Mathew Addy & Co., Pittsburg; secretary-treasurer, H. M. Lane, THE FOUNDRY. These nominees were unanimously elected to their respective offices, and Mr. Lane then reported that the following committees had been recommended: Committee on constitution—C. T. Smith, U. E. Kanavel and P. C. White. Finance committee—H. E. Pridmore, John Hill, U. E. Kanavel, C. T. Smith, Jas. Darragh. Committee on entertainment—H. Evans, Wilfred Lewis, Geo. Borden, Chicago Pneumatic Tool Co., Philadelphia; John S. Wilberham, of the Baker Blower Co., Philadelphia; H. E. Mills, of the Syracuse Oil Co., Syracuse, N. Y.

These committees were all confirmed by the meeting and the president then called upon various gentlemen present to address the meeting and give their ideas upon the formation of the association and its objects. President Johnson first spoke briefly as to what was to be accomplished by the association, saying in effect what has already been outlined above.

Dr. Moldenke then stated that such an association had long been needed as the convention sometimes proved a great burden to the local committee and that it necessarily detracted from the real object of the association.

President elect McFadden of the American Foundrymen's Association, spoke in a similar vein, stating that the new administration expected to accomplish great things now that the co-operation of the supply men was assured.

Mr. Johnson called on Mr. John A. Penton, of the Penton Publishing Co., for his ideas on the association. Mr. Penton said that 10 years ago he would not have believed it possible that the American Foundrymen's Association could attain the commanding position which it today occupies, and he predicted that in the next 10 years the improvement would be as great and that the increase in membership would keep pace with the improvement. He stated that the difficulty of providing for the entertainment features for a society like that of the American Foundrymen's Association was appreciated only by those who had done so. It was unfair to the association to compel it to bear the burden of a varied and expensive entertainment, the chief benefit of which was reaped by the supply men and he was glad to see that the supply men were now ready to do their part. He suggested for the benefit of the committee on constitution that membership in the Foundrymen's Supply Association should be conditional upon membership in the American Foundrymen's Association, and that no one be allowed to exhibit at a convention of the latter association unless he was a member of the supply men's organization. Mr. Penton then spoke of the educational value to foundrymen of the American Foundrymen's Association, and stated that it would repay the owners of foundries many times over to send their foremen to their conventions and pay their expenses.

The Iron & Steel Foundry, Monterey, Mex., in 1905 had an output of 20,125 tons, divided as follows: Structural iron, 8,239 tons; commercial iron, 9,445 tons; steel rails, 1,944 tons; and steel union plants for rails, 497 tons.

SITUATION IN THE MOLDERS' STRIKE.

Although five foundries in Milwaukee have settled with the union and have signed agreements, they employ but 157 molders. Twenty-two foundries, employing 2,300 men, have declared for the "open shop" and have not settled. Of these 17 are members of the Milwaukee Metal Trades and Founders' Association; the other five have been operating as "open shops" for some time.

"Open shop" notices have been posted in the various plants and the position of the foundrymen has been made clear through newspaper statements. They are all running their plants at from 50 to 60 per cent of capacity with non-union help. One shop, which three weeks ago had not a man in its foundry, now has about 100 men doing efficient work and is gaining new recruits daily. A number of its men in South Milwaukee have made overtures through their officials to see if they could return to work on the terms and wages prevailing prior to the declaration of the strike. The company has refused to meet them in conference and has stated that the only way they could return would be as individuals. This program will be adhered to in the belief that a malleable shop should be an "open shop," and that it is only a matter of time until it will be accepted. Machines are being introduced very generally in Milwaukee foundries. Manager Neacy, of the Filer & Stowell Co., says, "The strike has been a blesing in disguise as it has taught us the use and value of molding machines."

"The foundrymen of Milwaukee," says the president of one of the largest concerns involved, "feel confident of winning and will never yield again to the union. The 'closed shop' is un-American, unjust and unconstitutional and never will flourish in this country. The quicker all employers realize this and fight for the 'open shop' principle the better it will be for the employe as well as the employer and all concerned."

Buffalo Situation.

Three hundred and fifty of the eight hundred striking molders have returned to work without signed agreements or promises from the concerns in the Buffalo Foundrymen's Association. The only concession made by the employers to date was a slight increase given the minimum men in each shop where men returned. This was an increase of twenty cents per day without definite promises of employment.

Foundrymen in Buffalo declare the present fight will be to a finish and that no union recognition will be granted. The unions insist on having written agreements with employing concerns. The demands for shorter hours and increased pay are considered incidental to union recognition. Members of the Buffalo Foundrymen's Association feel aggrieved over the action of the union men in going out on strike. When they settled with the men last November it was assumed that the agreements between the foundrymen and the molders should be effective for at least one year. At that time coremakers were raised from $2.35 to $2.50 per day. May 1 they demanded $2.75, or an increase of twenty-five cents per day.

Buffalo foundrymen for several months prior to the strike order had difficulty in securing a sufficient number of men to fill their contracts. In March and April heavy orders for castings came in. The association asked the business agent of the molders' union to supply more men, but none could be obtained from this source. Advertisements for union molders were published broadcast, but few responses were received. The strike was declared when many large orders had accumulated and foundries were seriously handicapped.

This significant notice has been issued by the Buffalo Foundrymen's Association:

"The members of the Buffalo Foundrymen's Association propose to operate their foundries hereafter strictly as 'open shops.' Competent molders will receive fair treatment, good wages and steady employment, based wholly on merit and efficiency. No 'shop committee' will be allowed to dominate over foundries. No restriction of output will be tolerated.

"Worthy boys who desire to apprentice themselves to the molders' trade, without union restrictions, will be encouraged.

"If any of our desirable former employes, who left our employ at the time of the strike of May 2 to 6 on our refusal to sign a closed shop agreement, desire to return to work, they can do so on the above conditions.

"We make this statement public and emphatic so that any loyal molders, with whom we have no dispute, will know exactly what to expect if they care to return to work."

The following firms have taken men back temporarily at practically the old scale: David Bell Engineering Works, Buffalo Foundry Co., Buffalo Pitts Co., Frontier Iron Works, Lake Erie Engineering Works, Lawler Iron Works, O'Brien's Foundry Works, John W. Pohlmann, Standard Foundry Co., W. P. Taylor Co. and H. P. Trout.

Ten firms which refuse any concessions and which have taken back no men are the following: American District Steam Co., Buffalo Crucible Casting Co., Buffalo Forge Co., Buffalo Scale Co., East Buffalo Iron Works, Charles F. Ernst's Sons Co., Farrar & Tuffts, Fillmore Avenue Foundry & Iron Works, Freis & Co., J. Ginther's Sons Co., Howard Iron Works, Niagara Machine & Tool Works, Niagara Radiator Co., Sherwood Mfg. Co., United States Cast Iron Pipe Co. and Zero Valve & Brass Mfg. Co.

The Molders' Side.

The *Iron Molders' Journal* for June devotes much space to the present strike. We copy the following paragraphs from its editorials:

The question which led to an open rupture in Philadelphia did not have any bearing whatever on the subject of written agreements, recognition of the union, or any question which can arise between employers and employes, organized or unorganized, except that of wages.

There is not a strike today, involving any member of the Iron Molders' Union, where the issue is to force the foundrymen to agree to operate a union shop.

In many instances the molders have requested written agreements, specifying that the hours and wages agreed upon shall prevail for a definite period of time, and this has been done as a protective measure, as several foundrymen have asserted in conferences, recently, that they desired to be free to reduce wages when the snow flies.

We desire to reiterate that at the present time, as in the past, the Iron Molders' Union is asking for hours and wages, and that every strike can be adjusted without any reference to either union or open shops, if an agreement can be reached either on the hours of labor or the wage rate.

Had the N. F. A. been more careful at one time in selecting those it took into its ranks we venture the assertion that its membership would be much larger than it is today; that fewer members would have resigned, and that wages and conditions in every district would be more on an equality, and that the present disturbance, costly to foundrymen and molders alike, would never have occurred.

Last November, Commissioner O. P. Brigg afforded some quiet amuse-

ment by informing the N. F. A. convention that the membership of the I. M. U. had decreased about 50 per cent since the New York agreement was abrogated. Some men learn by experience, others do not seem capable of acquiring wisdom or knowledge, and, after having been hauled out of one pitfall straightway turn around and fall into another one.

In their bulletin of May 7 President Briggs and Commissioner Herendeen say: "With from 60,000 to 70,000 members of the Iron Molders' Union acting as a unit, the importance of co-operation among the foundrymen is apparent." In the bulletin dated May 16, this additional information is offered: "It can be readily seen that with a total membership of not to exceed 50,000 and nearly 10,000 being exempt from paying the weekly tax because being out of work, the regular net income of the union is not to exceed $14,000 per week."

From their official statements our membership last November had decreased 50 per cent, which would have left us with about 35,000 members. On May 7 we had from 60,000 to 70,000 members acting as a unit, and on May 16 we had not to exceed 50,000, and 10,000 of these exempt from paying dues.

If these gentlemen are engaged in a guessing contest for the amusement of their members there exists no cause for interrupting their pastime, but if they secure and furnish accurate information, we most humbly submit that they should deliver a fair and honest day's work for a fair day's pay.

Anti-Trust Injunction.—The circuit court of the United States for the northern district of California recently entered a decree in favor of the government in suits brought against a number of elevator manufacturing concerns on the charge of violating the federal anti-trust laws. A perpetual injunction was granted enjoining these companies from violating any provisions of the Sherman anti-trust act in the way of commercial or trade agreements or from entering into any agreement or understanding as to division of territory or as to prices. The court retained the right to make any further or additional decree which might be deemed necessary.

Ore Analyses.—The annual booklet issued by the Lake Superior Iron Ore Association, showing complete average cargo analyses of Lake Superior iron ores for the season 1905, has been issued and will be sent on application by W. B. Treat, Rockefeller building, Cleveland.

IRON MEN ENTER COAL FIELD.

The Canaan Coal Co. is opening up a coal mine on its recently acquired property in Canaan township, Athens county, O. The coal is the Hocking vein and is from six feet to nine feet in thickness. The tract consists of 6,000 acres and is crossed about midway by the Hocking river and the B. & O. S. W. R. R. in the river valley, with Canaanville as the railroad station. One mine is now being put down and the air shaft is completed. The depth of the coal is about 400 feet from the surface. It is planned to equip this mine with a steel tipple and the very best machinery and equipment obtainable for mining, hoisting and preparing the coal. A coal washer will be erected. It is the intention that everything shall be in keeping with the size and importance of the property. This is the most southerly extension of the Hocking coal yet developed and is proving to be as fine a development of the Hocking coal as has yet been found. The quality of the coal found in the bottom of the air shaft is very good.

The company is an incorporation under the laws of Ohio, and the ownership lies in some Jackson, O., men who have heretofore been interested only in the manufacture of iron, namely, John E. Jones, of the Globe Iron Co., and Charles O. Brown and Lewis V. Brown, of the Star Furnace Co. Lewis V. Brown is the general manager of the coal company, the office of which for the present is at Jackson, but soon will be moved to Canaanville. The plans and specifications for the equipment and machinery have not yet been prepared, but that question is being taken up and will be rushed as rapidly as possible, and then contracts will be let for the outfit desired.

Barney & Smith Meeting.—At the annual meeting of stockholders of the Barney & Smith Car Co., held last week at Dayton, O., officers were reelected as follows: J. D. Platt, president; A. M. Kittridge, vice president; H. M. Estabrook, vice president; and F. Kiefaber, secretary and treasurer. Net profits for the fiscal year ending April 1, 1906, were placed at $539,000. It is stated that orders are now on the company's books for cars to the value of $6,000,000. The new steel car plant is in operation.

Mining Institute.—The twelfth annual meeting of the Lake Superior Mining Institute will be held Aug. 8, 9 and 10 in the copper country. A. J. Yungbluth, Ishpeming, Mich., is secretary.

REMARKABLE OPEN-HEARTH FURNACE WORK.

The new open-hearth furnaces at the Lackawanna Steel Co., at Buffalo, have been doing some remarkably good work. None of the five new furnaces of this type has, as yet, been out for repairs, but the first to be put in commission, No. 7, has already made 300 heats without repairs, and is good for from 50 to 100 heats more, the ports and roof being in absolutely perfect condition, the only weak spot being that the checkers are clogging up, so that the furnace is only making from 15 to 16 heats a week. This is doing exceedingly well when it is considered that this is on producer gas and all cold metal, and that the heats average over 60 gross tons ingots. Last week No. 11 made 20 heats, producing 1,260 gross tons ingots, an average of 210 tons ingots per day, with 414 pounds of coal per ton ingots, and this on producer gas and practically a cold metal charge, as the small amount of hot metal available, being high in silicon, required as much time to work down with ore as was gained by having the metal hot, and being used in such small quantities that no time was saved over the use of a straight cold metal charge. The equipment for getting stock up to the furnace is inadequate and is being remodeled, so that abnormal delays occurred during this week's performance. This furnace actually stood idle, waiting for stock for 13 hours and 15 minutes during the week. The credit of this performance belongs to T. S. Blair Jr., who designed the furnaces, and R. T. Harris, superintendent of the open-hearth department, both of whom are well known to the open-hearth world. The original six furnaces are now being remodeled to conform as nearly as possible to the proportions of the new furnaces and when the construction work has been finally completed, some interesting developments may be looked for from this plant.

Rolling Mill Engines.—The C. & G. Cooper Co., Mt. Vernon, Ohio, has been awarded contracts by the Carnegie Steel Co., for three tandem compound condensing rolling mill engines. Two 32 x 52 x 60 engines will be installed at the Homestead works, for driving direct connected roughing and finishing rolls. One 42 x 74 x 60 will be installed at the Duquesne Steel Works.

The sales agents of the Republic Iron & Steel Co., and the Tennessee Coal & Iron Co., held one of their general meetings at the Pittsburg headquarters last Friday.

PERSONALS.

Jacob Ginsburg has resigned as president of the Girard Iron & Metal Co., Philadelphia, and will go abroad for a time.

D. B. Meacham and E. L. Billingsley, both of Rogers, Brown & Co., have been elected directors of the Iroquois Iron Co.

W. A. Bole, vice president of the Westinghouse Machine Co., and manager of the foundries, sailed for Europe last week on a short vacation.

S. W. Vaughan, for six years superintendent of blast furnaces at the Lorain plant of the National Tube Co., has tendered his resignation, effective June 15.

E. M. Zehnder, who has been general superintendent of the Scranton Bolt & Nut Co., Scranton, Pa., has been chosen president to fill the vacancy caused by the recent death of William D. Zehnder.

Hollinshead N. Taylor, of N. & G. Taylor Co., tinplate manufacturer of Philadelphia, and vice president of the Maryland Sheet & Steel Co., sailed on the S. S. Amerika on June 7 for an extended trip abroad.

W. S. Stoop, superintendent of Millikin Bros., and W. J. Jewell, superintendent of the roll department of the same company, were in Pittsburg last week looking after the equipment of the new Staten Island mill.

H. A. Marting, president of the Marting Iron & Steel Co.; J. G. Battelle, president of the Columbus Iron & Steel Co.; and J. H. Frantz, treasurer and general manager of the latter, are making a tour of Lake Superior ore properties.

George E. Rose has been appointed to succeed O. O. Laudig, who recently resigned as superintendent of blast furnaces of the International Harvester Co., South Chicago. Mr. Rose was formerly superintendent of the Edgar Thomson Steel Works.

Thomas A. Beattie has been appointed general manager of the Riverside department of the National Tube Co., succeeding Frank H. Crockard. He has been superintendent of the converting steel and skelp departments of the mill for a number of years.

W. A. Williams, acting district manager of the American Car & Foundry Co., has been appointed district manager in charge of the Madison steel car plant, the St. Louis wood car shops and the St. Louis steel foundry. He will also have charge of the new steel car plant in St. Louis.

W. E. Priest, foreman and superintendent of the blacksmith department of the Western Steel & Car Foundry Co., Anniston, Ala., has resigned to become general manager of the Forge Co., of North Birmingham. He is succeeded by J. J. Donnelly, of Atlanta.

Richard Penhale succeeds T. P. Bisland as superintendent of the Hudson mine, formerly the Forest of Dean mine in Orange county, N. Y. Earl C. Bacon has been retained as consulting engineer of the Hudson Iron Co. which is opening the Hudson mine and also a deposit of brown hematite near Hacketstown, N. J.

Joseph Lodge, president and general manager of the Holt furnace of the Central Iron & Coke Co., recently resigned to accept a similar position with the Woodward Iron Co., of Birmingham. He was presented with a number of valuable gifts by officials and employes of the Central company and the citizens of Tuscaloosa.

David O. Holbrook, until recently vice president of the Pennsylvania Malleable Co. and the Central Car Wheel Co., has been elected vice president of the Dayton Pneumatic Tool Co., Pittsburg, Pa., manufacturing the Green clipping and riveting hammers, and has opened an office for the company at 717 Park building, Pittsburg, Pa.

H. O. Cary, for many years superintendent of the American Steel & Wire Co.'s plant, at De Kalb, Ill., has resigned and will remove to a climate more favorable to his health. On his retirement he was presented with a gold watch and chain, a diamond set locket and other gifts by the officials and workmen with whom he had been associated.

Prof. Sydney A. Reeve, of Worcester, Mass., has resigned his position at Worcester Polytechnic Institute to devote his time to private consulting engineering practice. For ten years he has been professor of steam and hydraulic engineering and is well known as a specialist along these lines. Prof. Reeve will not give up teaching entirely, as he will continue to give a course of lectures at Harvard university.

The readjustment of officers of the Colorado Fuel & Iron Co., following the resignation of C. S. Robinson, general manager of the iron department, has been completed. J. B. McKennan becomes manager of the Minnequa plant and general superintendent of the middle division of the C. & W. railroad; J. A. Durfee becomes superintendent of the Minnequa plant, and J. D. Gilchrist, who was superintendent of mines under Mr. Robinson, becomes manager of operation of the mines.

OBITUARIES.

Geo. F. Buss, president of the Buss Machine Co., Muskegon, Mich., died recently of nervous prostration. He was 59 years of age.

James Watson, superintendent of the Combination Steel & Iron Co.'s plant, Chester, Pa., recently committed suicide. He was 70 years of age.

William Oldman, who held the distinction of being the oldest boilermaker in Buffalo, died May 26, at the age of 82. He was connected with a number of firms in that city, and for a time engaged in business for himself, but retired several years ago.

Geo. B. Forrester, for the past 10 years superintendent of No. 3 open hearth mill of the Homestead plant of the Carnegie Steel Co., was found dead in bed Monday morning June 11. Heart failure was the cause of his death. He was 37 years old and is survived by a widow and one daughter.

Peter M. Hitchcock, a pioneer Ohio ironmaster, died at his home in Cleveland, June 9, at the age of 67. He came from a distinguished family which early settled in the Western Reserve. He was educated at Painesville, O., and at Western Reserve College and in 1853 went to work at a blast furnace near Ironton, O. A year later he went to the rolling mills at Youngstown, then enlisted in the Union army. In 1865 he located in Cleveland and organized the iron and steel firm of Cleveland, Brown & Co., in which he was active until its purchase by Bassett, Presley & Co. in 1892. He was one of the organizers of the Moon Run Coal Co., which was absorbed in 1898 by the Pittsburg Coal Co., of which he was a director for several years. He was also interested in the Mahoning Valley Iron Co., the Brown-Bonnell Iron Co., of Youngstown, the Vulcan Steel Works, of St. Louis, and the Hamilton Steel & Iron Co., of Hamilton, Can. He was an active member of a large number of financial, manufacturing and philanthropical institutions. Two of his sons are connected with the Lincoln Electric Mfg. Co.

The Transcontinental Railway Commission (Canada) has received four tenders for supplying 65,000 tons of steel rails for the Grand Trunk Pacific. Two are from the Dominion Iron & Steel Co., of Sydney, N. S., and the Algoma Steel Works, of Sault Ste. Marie, one from the United States and one from Britain. It is expected that the Canadian firms will get the order between them.

OPEN-HEARTH STEEL CASTINGS.—VI.

BY W. M. CARR.

Basic Practice (Continued).

In charging cold stock about one half of the time required to work a fifteen to a twenty-ton heat is taken up in melting. As that interval advances the slag is increasing in volume and some changes in composition will take place in the first portions of the metals melted. The slag is more or less viscous with lumps of lime coming to the surface as it becomes loosened from the bottom. There is a foaming or bubbling in the slag caused by the CO_2 being liberated from the limestone and also by the action between the oxides of the slag and the carbon of the bath. As the lime continues coming to the surface it increases the basicity of the slag and with that condition there will be a rapid absorption of phosphorus from the bath.

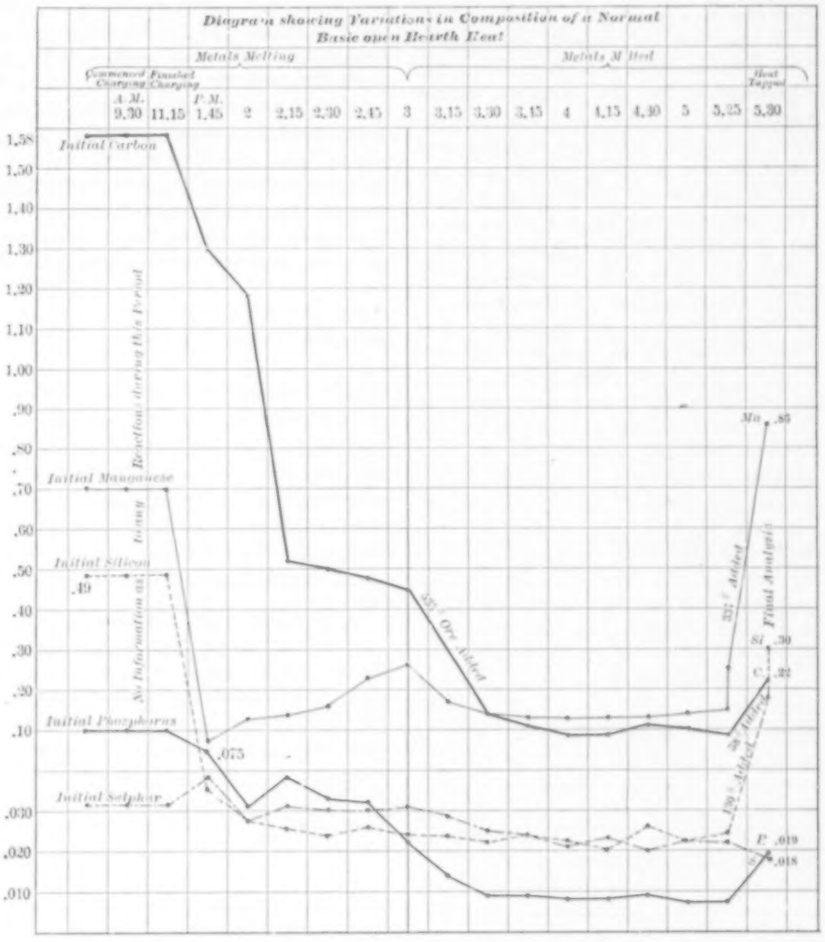
The operator feels over the bottom of the furnace with a long bar to determine whether the bath is entirely melted or not. If no pasty masses are touched the bath is completely molten. A sample of metal is then poured into a small oblong mold, quenched and broken to study the fracture, the appearance of which indicates the carbon present and also whether there may be any phosphorus remaining. An experienced eye can readily read the carbon of the test quite closely. If the grain is small and the fracture of rather a dull color, the heat is said to have melted "hard." If the grains are large and bright the heat has melted "soft." Other indications confirm this in the way the first test piece may break under the blows of a sledge, the "hard" or high carbon steel snapping easily, while the "soft" or low carbon steel bends or flattens before fracture.

To confirm the melter's judgment, as a rule, the first test piece is sent to the laboratory for a quick test on carbon and phosphorus. When the test piece indicates a high carbon, the melter does not wait for the analysis, which only occupies about ten minutes, but may throw into the bath a few shovels of iron ore to assist in the lowering of the carbon, and, at the same time, thin the slag. In a few moments the chemist reports carbon usually 0.50 to 0.70 with only a trace of phosphorus. The melter is now satisfied that his conditions are normal. Should the phosphorus have shown incomplete removal in the first test, a second one would be taken after an interval of about fifteen minutes and submitted to another chemical analysis. The addition of the iron ore immediately after the first test would have increased the slag's basicity and fluidity and no doubt would have eliminated what phosphorus might have remained in the bath at the time of the first sample. Usually the second test shows phosphorus out of harm's way.

Should the phosphorus resist removal, that would necessitate an addition of lime to the slag which would have a tendency to cool the bath and also raise the lime content of the slag and of course intensify the de-phosphorizing action. If the temperature of the bath at melting be very high, there may be a tendency to retard the removal of phosphorus, since there seem to be certain ranges of temperature wherein de-phosphorizing does not depend entirely upon slag conditions. It has been observed that in cases where a normal slag would refuse to completely de-phosphorize, an addition of a few hundred pounds of pig iron caused a quick and perfect absorption of that element by the slag. The action could only be explained on the basis that the pig iron so added could exert no other influence regarding the phosphorus than that of cooling the bath. This fact gives plausibility to the theory of the thermal ranges where they may be a change or reversal of affinities, or, in other words the oxidizing action is more inclined to give its attention to the carbon in preference to the phosphorus.

The activity in de-carbonizing is one that varies with the temperature and this fact also seems to apply with equal force inversely to phosphorus. The term "very hot" may seem indefinite in reference to the bath when melted, but in the absence of figures stating temperatures at the several stages of an open-hearth heat, the use of vague expressions concerning them cannot be avoided. It is doubtful that the slight ranges of temperature covering the periods affecting the removal of phosphorus can be observed by the eye even with experienced operators. It is certain that the ranges of temperature in question come within apparently normal conditions and are therefore narrow. But, if the said ranges were wider, they would be readily detected without the seeming need of pyrometry to fix them.

Assuming the second test sample shows a very low phosphorus, usually



COMPOSITION OF A NORMAL BASIC OPEN-HEARTH HEAT.

0.005—0.015, further manipulation proceeds smoothly. The slag will have nearly reached its full share of lime, in other words, the lime will have come to the surface from the hearth bottom where it was charged. If the dose of iron ore has not given the desired fluidity to the slag, an addition of two or three shovels of fluor-spar will bring it about quite rapidly. Fluor-spar should be used but sparingly because excessive doses tend to aggravate the cutting action on the slag line around the hearth.

If the first or second preliminary test samples show low phosphorus the examination for that element is not carried out in subsequent tests. Only the carbon is carefully watched and after it has reached about 0.25 no further ore should be given to a bath. The carbon reduction can go on without any asistance from that source because the slag will, at that period, carry its full quota of iron oxide to actively promote decarburizing. Excessive additions of iron ore will surcharge the bath with oxide which causes blow holes and red shortness in the finished product. A liberal use of iron ore will shorten the time of making a heat and in a measure, increase the yield of metal because the reaction between the carbon of the bath and the oxide of iron furnished by the ore sets free an equivalent of metallic iron which enters the bath. But good practice demands discretion in the treatment of the bath with ore.

It generally follows that when a heat melts "hard," temperature conditions at the end of the heat will be normal because the initial amount of carbon wil be high enough to produce perfect liquation and present a great enough interval of time occupied in its removal to preserve proper thermal adjustments by regular reversals of flame action, inflowing air and outgoing gases. Should a heat melt "soft," the temperature of the bath is apt to be low and without a gain in the carbon much difficulty would be encountered with pasty steel. An attempt to raise the flame temperature to get the fluidity of the bath would be harmful to the roof and brick work of furnace through scorching. But recourse is had to extra doses of cold pig iron to furnish the necessary carbon and thus promote fusion and other desirable conditions. Such practice is called "doctoring" but the outcome is never so satisfactory as when the heat is worked naturally. It is a safe rule that when a heat melts "soft" and consequently dull or cold, that the first preliminary test will show through slag absorption of phosphorus. This fact gives plausibility to the theory of the temperature ranges affecting the removal of that element.

When the carbon reaches a point where the test samples are very tough, difficult to break and showing, upon fracture, a fibrous structure, and chemical tests show them to be between 0.10 to 0.14 carbon, preparations are made to finish the heat. If a test spoon of liquid steel be taken from the bath and poured over the lip, running freely and leaving the spoon clean and free from skull or chilled steel, the temperature of the bath is considered good. The next step will be to quiet the bath by adding one-third of a weighed portion of ferro-managanese. This material as shown in previous sections takes precedence over the remaining carbon in de-oxidizing and so lessens the ebullition of gaseous carbon. After an interval of a few minutes the heat of metal is tapped into a pre-heated ladle and before the slag comes the final doses of ferro-manganese and ferro-silicon are then thrown in with the stream of steel and the heat is said to be finished. The furnace bottom is now drained of slag and some remaining pools of steel. The slag line is patched with raw dolomite and whatever holes there may be in the bottom are filled with ground magnesite. The furnace is then ready for a succeeding charge.

Details of Re-carburizing.

It will be noted that in basic melting no ferro-silicon is added to the bath to deoxidize as in acid practice. To do so would be to invite irregularities such as a release of phosphorus from the slag, a re-absorption of it in the bath, a cutting of the hearth, a great loss in available silicon and uncertainty as to quality of product. The measure of the power of the slag to take up phosphorus from the bath is its basicity and any addition of silicon decreases that property. The better practice is to make the silicon additions entirely in the ladle. If the ordinary grade of ferro-silicon (nine per cent—13 per cent Si) is used, it must be melted before it can be added to the ladle.

The melting may be done in a small cupola, or a reverbatory furnace fired with coal, or in a suitable oil furnace. In any case, there are certain annoyances, such as hitches in getting the ferro-silicon melted at the proper interval and in condition to transfer the desired quantity to the steel ladle when the heat has been tapped from the open-hearth furnace. There are also losses in available silicon due to oxidization when melting the charge of ferro-silicon by any method. These losses are variable and cannot be avoided. In making calculations allowances must be made for such losses. It would not be practical to add the dose of ferro-silicon, using the common grade, cold. The drawbacks just mentioned can be avoided by the higher grade electrolytic ferro-silicon which usually carries about 50 per cent silicon. The quantity of this latter grade for a dose is only about one-fifth of the commoner kind, so that there is no need to melt it before using, thus eliminating the difficulties arising in handling the ordinary grade. The heat units evolved in the reaction between the oxide of iron contained in the molten steel and the silicon available in the high grade ferro-silicon, more than offset any chilling effect set up by the addition of a cold charge of that material. There is always some consumption of silicon in de-oxidizing and it is greater in basic melting than in acid. The loss varies between 20 per cent to 30 per cent of the total available, particularly in using the common grade of ferro-silicon.

The greater part of the ferro-manganese addition can be made in the ladle with but a slight loss in de-oxidizing and with no chilling effect upon the liquid steel.

If the finished product is to show a final analysis as follows:

C ..... 0.20 to 0.25 per cent.
Si ..... 0.30 to 0.35 per cent.
Mn ..... 0.65 to 0.85 per cent.

the calculations for the recarburizers, will be, as an illustration, made on the basis of molten Fe Si with nine per cent to 13 per cent Si and also on Fe Si carrying 50 per cent Si, the weight of the charge being 36,000 pounds. Taking the lower limit of silicon in final analysis there will be required

$$36{,}000 \times 0.003 = 108 \text{ pounds Si.}$$

With the ferro-silicon averaging 11 per cent silicon the charge of that material to furnish 108 pounds silicon is

$$\frac{108 \times 100}{11} = 928 \text{ pounds,}$$

but there may be a combined loss of the synthetical silicon in melting and in de-oxidizing of about 20 per cent; it will be necessary to increase the charge of ferro-silicon accordingly to $982 \times 1.2 = 1{,}178\frac{1}{2}$ pounds. The carbon carried in by that quantity will be

$$1{,}178\frac{1}{2} \times 0.015 = 17.67 \text{ or } 18 \text{ pounds}$$

divided by the weight of the charge

$$\frac{18}{36{,}000} \times 100 = 0.04,$$

the percentage of available carbon.

To get the manganese in final analysis to equal say 0.75 per cent it will be necessary to add:

36,000 x 0.0075 = 270 pounds Mn.

Standard ferro-manganese carries 80 per cent, then to have the synthetical manganese it will require

$$\frac{270 \times 100}{80} = 337\tfrac{1}{2} \text{ pounds FeMn.}$$

The residual manganese in the bath at the time of additions will be an increment and it will nearly equal the loss mentioned in available manganese. From the ferro-manganese there will be carbon furnished to the extent of

337½ x 0.06 = 20¼ pounds.

$$\frac{21}{36{,}000} \times 100 = 0.05 \text{ per cent C.}$$

The addition of ferro-manganese is divided into two portions, 1-3 in furnace and 2-3 in the ladle.

Summarizing the recarburizers there will be available in total elements.

	Residual.	Fe-Si.	Fe-Mn.	Total available.
C	0.12 +	0.04	0.05	0.21 +
Mn	0.15 +	—	0.75	0.90 >
Si	0.02 +	0.36	—	0.38 >

The foregoing available composition in regard to the carbon will be very close to the required analysis and the complete analysis compared with the total available elements will depend in a great measure upon the condition of the bath in regard to the quantity of oxide formed during the conversion and refining of the charge.

If the electrolytic ferro-silicon be preferred to the common grade, it will not change the details in regard to the dose of ferro-manganese which will remain the same as shown in preceding paragraphs. The figures for silicon can be taken as follows:

36,000 x 0.003 = 108 pounds Si.

$$\frac{108 \times 100}{50} = 216 \text{ pounds Fe-Si.}$$

Since the electrolytic silicon being in a condensed form the de-oxidizing effect is more pronounced and efficient. The losses are much less than in the ordinary grade. There arises no particular need to take into account the losses or differences between the synthetical analysis and the final. It is not necessary in adding silicon as a deoxidizer to work extremely close to figures for finished analysis, if enough is added in the first place to accomplish the purpose. The amount of carbon furnished by the electrolytic silicon is quite small, 216 x 0.0025 = 0.054 pounds and $\frac{0.54}{36{,}000} \times 100 = 0.001$ per cent or practically nothing at all. From the ferro-manganese there will be 0.05 per cent which added to the residual, assumed to be 0.12 per cent, would make the available carbon 0.17 per cent, a figure rather low for ordinary castings where the tensile strength required may be 60,000 to 70,000 pounds per square inch.

Two methods may be followed to raise the carbon to 0.20—0.25 per cent. One is to finish the heat at a correspondingly higher residual carbon. The other is to make up the difference between 0.17 and 0.20—0.25 by an addition of solid carbon in the form of coke or anthracite at the time of dosing in the ladle.

Concerning sulphur, there is no great effect upon it at the time of recarburizing. The figures for the residual and the final analysis are practically the same excepting occasionally a small decrease coming within the common errors of chemical tests. If any differences occur outside of them, the lessening of the sulphur can be assigned to the influence of manganese in combining with some sulphur and passing off into the slag as a manganese sulphide. No gain in sulphur at this stage has been observed in the writer's experience.

If the initial phosphorus is kept low in the charge about, 0.10 to 0.15 per cent and with only 0.005—0.015 per cent remaining at the time of finishing the heat, the synthetic silicon in the action of de-oxidizing in the ladle changing to silica passes into the super-natent slag, combines with the lime, liberates or releases some phosphorus held there, which immediately reverts to the molten metal and raises the analysis of that element. Under such conditions, taking a sample when about one-half of the metal from the ladle has been poured, there will be found a marked increase of the phosphorus over the residual so that the finished steel will show 0.02—0.03 P. The re-phosphorizing in the ladle goes on continually so long as the metal remains liquid and if a sample were taken from the last portion of metal in contact with the slag, there would be found a still further gain in phosphorus. If a much higher initial phosphorus were charged there would be a still greater reversion, and castings poured at the end of a heat might be found with a content of phosphorus near the point of being objectionable. This feature of re-absorption is peculiar to the basic process and is more noticeable in the steel castings practice than in the production of ingots for rolling purposes, because in the latter product the silicon added at the end of a heat is much less than in the former. Hence the importance of not charging large quantities of highly phosphoritic stock in the manufacture of basic steel castings.

The melting losses depend upon the character of the stock and the conditions of practice and may vary from six per cent to 12 per cent of metal charged. In representative plants with established and extensive experience a yield of 93 per cent in the ladle can be considered a fair average.

THE ELECTRIC CRANE IN THE FOUNDRY.[1]

BY HARRY SAWYER

It is not the purpose of this paper to enter into a technical discussion of the electric crane, but such a presentation of the subject as will lead to a better understanding between makers and users cannot fail to be mutually profitable.

The use of the electric crane in the foundry doing heavy work has become so general that even a reference to the older methods, by way of comparison, seems uncalled for.

It may be interesting, as a bit of history, to note that the first three-motor electric traveling crane built in the United States, and probably in the world, was for use in a foundry. It was put in operation only a little over seventeen years ago. Although it was constructed from the wreck of an old rope-driven crane, it did good service night and day for nearly ten years. It was the invention of Alton J. Shaw, then employed by the E. P. Allis Co. as a designer, and was used in the foundry of its Reliance works, at Milwaukee.

There have been some interesting phases in the development and introduction of the electric crane. The skepticism of those in need of such machines, and the opposition of those engaged in the manufacture of the earlier types, was to be expected; but it is only fair to say that the users of cranes were quicker to recognize the advantages of the new type and to adopt it, than were the makers of the old.

The use of the electric motor and the sliding contacts, solved in so satisfactory a way the problem of transmitting power to a moving machine, that the traveling crane rapidly superseded the swinging crane in nearly all classes of foundry work where a crane is required. In one notable instance,—pipe foundry work—the swinging crane was retained. Whether this was due to some peculiarity of the work that made the circular pit and the circular movement essentially better than the rectangular pit and corresponding crane movements, or whether it was due to the natural persistency of estab-

[1] A paper presented at the Cleveland (June, 1906) meeting of the American Foundrymen's Association.

lished practices, seemed for a time to be an open question; but the recent equipment of several pipe foundries with traveling cranes, indicates that the latter was the correct explanation.

It is no doubt true that the foundry has set the standard of excellence for electric cranes. Some shops and mills may have heavier loads to handle and require greater speed, but the crane manufacturer recognizes that the perfect control required in the foundry, represents a higher state of development than mere requirements of capacity and speed. It should not be understood that good control is not required in mills and shops, particularly the latter, but as a rule the requirements of the foundry are much more exacting.

The conditions under which a foundry crane is operated, are less favorable to continued good service than the conditions in a machine shop. It is more subject to overload, and the dirt and dust necessitate more careful attention; furthermore, the men directly responsible are usually less familiar with machinery, with the result that the crane too often does not have the care that it should. It is a mistake to assume that a crane which does the work of an army of laborers, can safely be handled and cared for by one of that class. The importance of employing only thoroughly competent and conscientious operators, and keeping the cranes in perfect repair cannot be too strongly urged. Prompt attention will reduce the total cost of repairs and the extra cost of careful and competent men, will be saved many times in the more constant service and longer life of the crane.

There is at the present time something of a demand for excessively high speeds, and the motives of the manufacturers who advise against them, are sometimes misunderstood. It is not that the problem presents any difficulties from the manufacturer's standpoint. He may prefer to furnish a standard article, from considerations of cost and delivery, but oftener he is considering the direct benefit to the customer and the indirect benefit to himself. The manufacturer and user may recognize the same advantages, and disadvantages but from their different standpoint, they do not see them in the same proportion.

The one advantage sought in high speeds is a saving of time, but this is often overestimated. Take for example a 10-ton crane with full load speed of 20 feet per minute. We may assume that the average load will not be more than one or two tons, that the average speed for such load will be 30 feet per minute, and that the average lift is five feet. Allowing 50 per cent more time for acceleration from a state of rest, and we find the time for an average lift to be 15 seconds.

If the speed of hoist were doubled, it would at first appear that one-half of this time, or 7½ seconds, would be saved. If 20 lifts were made per hour, the result would be a saving of only about four per cent of the time. When it is remembered that many of the lifts must be very slow, regardless of what the crane is capable of doing, and that traverse movements are usually started as soon as the load is clear of surrounding objects and before the hoist movement is stopped, the actual saving is reduced to a very inconsiderable amount of time.

Where a large floor area is covered, a greater saving can be made by increasing speeds of horizontal movements, but the swaying of load which results from high speeds and sudden starting and stopping, sets a limit to the saving that can be made in this direction.

Two objections may be offered to excessively high speeds. First, the accidents that are likely to result from putting a high speed crane in the hands of an incompetent operator often cause the loss of much more time than is saved by the higher speeds, and greatly increase the cost of repairs. Second, if the crane is not usually run at full speed, there is a constant loss of power in the rheostat, and unnecessary wear and tear on the controller parts, both of which cause expense and loss of time. The above comparisons apply with the most force to cranes in foundries, and with least force to cranes in mills where much higher speeds are necessary and practical.

Next to the requirement of necessary strength in all parts for absolute safety, the most important point to be considered is perfect control of the hoisting mechanism. This depends upon three parts; the motor brake, the load brake, and the controller.

The motor brake is released by the current which operates the motor, and should require only as much current as is necessary to drive the machinery without load. It should be sufficiently powerful to bring the armature to a stop promptly, but without shock, when the current is interrupted.

The load brake is a far more important part. It must allow the machinery to run freely in hoisting, but prevent the load from descending, except when the motor is run in the lowering direction. In most, if not all forms of load brakes now in use, the brake is applied by the action of the load. They may be divided into two classes: one in which the brake pressure is not reduced in lowering, but the motor acts with the load to cause the brake to slip; and the other in which torsion of the motor in the lowering direction reduces the pressure between the surfaces, allowing the brake to slip and the load to descend. The most common of the first class is the enlarged step bearing on a worm shaft. It can be used only in connection with worm gearing. It is a very simple and may be made a very satisfactory working brake. The most serious objection to it is this: If proportioned to give a fair margin of safety with the best conditions of lubrication, it will take considerable power to lower with moderate or poor lubrication, for the motor must overcome any excess of holding power over that necessary to sustain the load. This extra work in lowering means loss of time and power, and greater wear of parts.

Of the second class, there are two types: the coil type and the disc type. Both have their advantages and disadvantages. The disc type is more substantial in construction, gives better distribution of pressure over the friction surfaces, and consequently a much lower unit pressure; and as the pressure is strictly in proportion to the load, it gives higher speeds in lowering light loads. It has this disadvantage, that it is more sensitive to irregularities in lubrication.

In the coil brake the pressure and wear are concentrated principally at one end. While the brake is applied by the action of the load, the pressure and resistance to slipping are not strictly in proportion to the load. The torsional effort of the motor to release the brake is dependent upon the proportions of the brake parts, and not upon the load, hence the speed in lowering is approximately the same for all loads.

Both types are used by reputable builders, and both may be designed to give good results.

A good controller is indispensable to a satisfactory crane. The essential parts of the controller are the resistances and the means for varying the amount of resistance in the circuit, according to the speed and power required. The most common practice is to divide the resistance into sections, connect the sections together in series and connect each section to one of a series of corresponding contacts. A brush is arranged to pass over those contacts, cutting more or less of the resistance into or out of the circuit. Various materials may be employed and details used to obtain the desired

result, but certain conditions must be complied with if satisfactory results are to be secured.

The total resistance may be sufficient to allow the passage of only enough current to start the motor at a very slow speed with its smallest load. The number of sections must be sufficiently great and the resistance of these sections sufficiently small that no sudden or abrupt changes of speed will occur from the time the first contact is closed, sending the current through the resistance, to the time that all the resistance is cut out, and the motor is given full current.

Durability of the controller and convenience in making repairs, are important considerations. The construction should be such that neither the resistance material or the supporting insulation will be injured by the heat. Conservative rating and good ventilation are required to keep the temperature down to a safe point. Sparking and burning of contacts cannot be entirely prevented, but proper proportion of resistance to avoid great changes in voltage between consecutive steps, and a well designed magnetic blowout will prevent serious burning. The brushes and contact pieces must be renewed occassionally, and they should be very accessible. It is important also that the resistance material should be removable without moving the controllers from their positions in the operator's cage. Economy of space, so far as it is consistent with proper sizes of parts, good ventilation, good insulation and accessibility is of importance.

Crane motors are usually series wound. It seems almost unnecessary to say that they should be very simple and strong mechanically, that the electrical insulation should be of the best quality and that they should be designed to stand great variations in speed and load, and sudden reversals under load without injurious effects. The highest possible efficiency at some one speed and load is not so important as a good average efficiency over a wide range. Motors of low or moderate speeds are preferable on account of the reduced gear ratio required between motor and winding drum or driving wheels.

Referring in a more general way to the design of cranes and the problems and limitations met by the designer, it is the exception rather than the rule, that he has free hands to do as he might wish. Limited space; close approach of hook to roof, sides, and ends of building; perfect accessibility of all parts; a large factor of safety; low price,—these are some of the requirements which, desirable as they may be, are not always compatible.

Manufacturers and users have underestimated the advantages to both of getting together. The manufacturer should understand fully the requirements of the user, and the user should know the full effect of the limitations he places upon the manufacturer.

PROGRAM OF AMERICAN SOCIETY FOR TESTING MATERIALS.

The program which has been arranged for the ninth annual meeting of the American Society for Testing Materials, to be held at Atlantic City, N. J., June 21, 22 and 23, includes a wide range of topics of which an unusually large number are of interest to iron, steel and manufacturing industries. The program follows:

Thursday Afternoon.

Minutes of the eighth annual meeting, annual report of the executive committee, and memoirs of deceased American investigators who have contributed in a marked degree to the advance of the testing of materials, by Gaetano Lanza.

Report of Committee H: On Standard Tests for Road Materials. Logan Waller Page, Chairman.

The Development of the Test for Cementing Value of Road Materials. Allerton S. Cushman.

Notes on the Hardness and Abrasion Test of Road Materials. P. L. Wormeley Jr.

Report of Committee L: On Standard Specifications and Tests for Sewer Pipes. Charles F. McKenna, Chairman.

Report of Committee P: On Fire-Proofing Materials. Ira H. Woolson, Chairman.

Report of Committee Q: On Standard Specifications for the Grading of Structural Timber. Herman von Schrenk, Chairman.

Miscellaneous business, and election of officers.

Thursday Evening.

Annual Address: The American Society for Testing Materials—Its Past and Future. The Vice President.

The National Bureau of Standards. S. W. Stratton.

Concrete Column Tests at Watertown Arsenal. J. W. Howard.

Some Effects of Earthquake Shock and Fire on Materials and Buildings at San Francisco. Richard L. Humphrey.

Friday Morning.

IRON AND STEEL SECTION.

The Corrosion of Steel as Affected by its Chemical Composition. J. P. Snow.

Electrolytic Corrosion of Steel. Maxmilian Toch.

Topical Discussion on the Corrosion of Iron and Steel. This discussion will be opened by H. M. Howe, Allerton S. Cushman and James Christie.

Report of Committee F: On Heat Treatment of Iron and Steel. H. M. Howe, Chairman.

The Effect of Heat Treatment on High Carbon Steels. William Campbell.

The Beneficial Effect of Adding High-grade Ferro-silicon to Cast Iron. A. E. Outerbridge.

CEMENT AND CONCRETE SECTION.

Report of Committee I: On Reinforced Concrete. F. E. Turneaure, Chairman.

Tests of Reinforced Concrete Beams. Gaetano Lanza and S. J. Tilden.

Note on Compression Tests of Cement. W. P. Taylor.

Consistency of Concrete. Sanford E. Thompson.

The Present Status of Our Knowledge in Regard to the Constitution of Portland Cement. Clifford Richardson.

Progress Made in the Investigation of Structural Materials During the Fiscal Year Ending June, 1906. R. L. Humphrey.

Friday Afternoon.

IRON AND STEEL SECTION.

Report of Committee A: On Standard Specifications for Iron and Steel. W. R. Webster, Chairman.

Discussion on Standard Specifications for Ship Material. Opened by Mr. E. P. Stratton and Mr. W. R. Webster.

Experiments on the Segregation of Steel Ingots in its Relation to Plate Specifications. C. L. Huston.

Fire-box Steel—Failures and Specifications. Max H. Wickhorst.

PRESERVATIVE COATINGS SECTION.

Report of Committee E: On Preservative Coatings for Iron and Steel. S. S. Voorhees, Chairman.

Protective Coatings for the Preservation of Steel. Arthur B. Harrison.

Practical Testing and Valuation, Japan. Robert Job.

Testing of Shellac Varnish. A. C. Langmuir.

Saturday Morning.

METALS AND FUELS SECTION.

Report of Committee B: On Standard Specifications for Cast Iron and Finished Castings. Walter Wood, Chairman.

Report of Committee J: On Standard Specifications for Foundry Coke. Richard Moldenke, Chairman.

Some Results of Government Fuel Tests at St. Louis. J. A. Holmes.

Report of Committee M: On Standard Specifications for Staybolts. H. V. Wille, Chairman.

Report of Committee O: On Uniform Speed in Commercial Testing. Paul Kreuzpointer, Chairman.

Report of Committee T: On the Tempering and Testing of Steel Springs. J. A. Kinkead, Chairman.

Report of Committee R: On Uniform Specifications for Boilers. E. D. Meier, Chairman.

Tension Tests of Steel Angles. F. P. McKibben.

CEMENT, CONCRETE AND ASPHALT SECTION.

Investigation of the Conductivity of Concrete and the Effect of Heat Upon its Strength and Elastic Properties. Ira H. Woolson.

The Determination of the Specific Gravity of Cements. R. K. Meade.

A New Device for the Mechanical Sifting of Concrete Aggregates. C. N. Forrest.

Relation Between Some Physical Properties of Bitumens and Oils. A. W. Dow.

The Proximate Composition and Physical Structure of Trinidad Asphalt, with Special Reference to the Behavior of Mixtures of Bitumen and Clay. Clifford Richardson.

Some Sand Experiments Relating to Per Cent of Voids and Tensile Strength of Cement Mortars. J. Y. Jewett.

Saturday Afternoon.

WATERPROOFING AND TESTING MACHINE SECTION.

Report of Committee S: On Waterproofing Materials. A. W. Dow, Chairman.

Some Mistakes in Waterproofing. E. W. DeKnight.

Methods of Testing Cements for Waterproofing Properties. W. P. Taylor.

Discussion to be opened by Mr. E. W. Lazell.

Report of Committee K: On Standard Methods of Testing. Gaetano Lanza, Chairman.

New Features of Two Large Testing Machines. W. C. Du Comb Jr.

The Purdue University Impact Machine. W. K. Hatt and W. P. Turner.

MISCELLANEOUS SUBJECTS SECTION.

Report of Committee G: : On the Magnetic Testing of Iron and Steel. Walter J. Esterline, Chairman.

A Complete Equipment for Magnetic Testing. Walter J. Esterline.

Mechanical Experiences with Limber and Stiff Rail Sections. P. H. Dudley.

The Effect of Combined Stresses on the Elastic Properties of Iron and Steel. E. S. Hancock.

Tests of Metals in Reverse Torsion. E. S. Hancock.

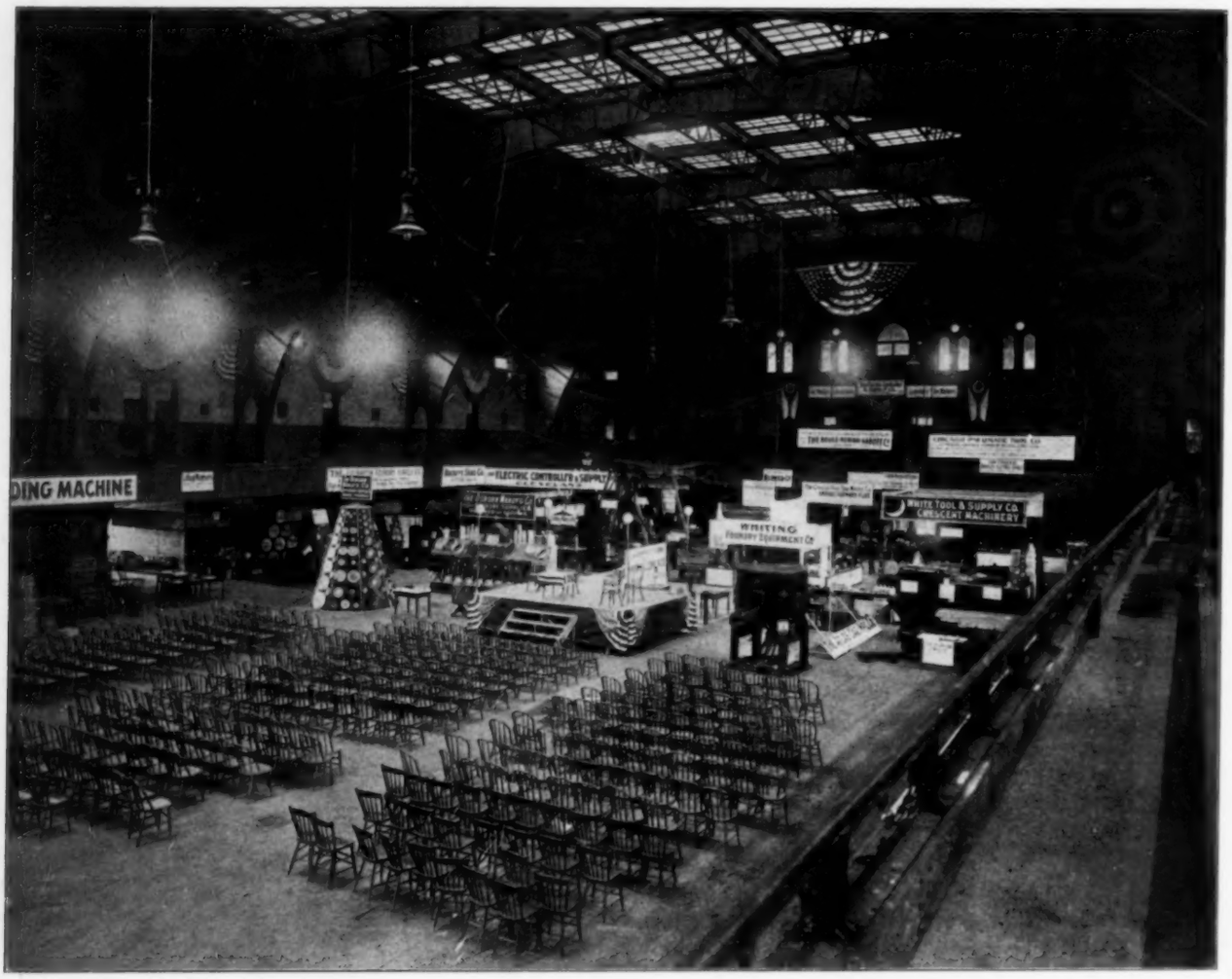
Additional Data on the Rattler Test for Paving Brick as Disclosing the Limit of Permissible Absorption. Edward Orton Jr.

Announcement of official papers and reports and non-official reports to be presented at the fourth congress of the International Society of Testing Materials, to be held at Brussels, Sept. 3-8, are being distributed by Edgar Marburg, Philadelphia, secretary-treasurer of the American society.

The downward movement of iron ore through the canals at Sault Ste. Marie during May was 3,916,592 tons out of a total freight movement of 4,621,827 tons.

The American Foundrymen's Association at Cleveland.

The report of the convention of the American Foundrymen's Association in THE IRON TRADE REVIEW last week concluded with the session of Tuesday afternoon. The convention was the most successful in the history of the association not only in point of attendance, but in the number of exhibits of supplies and in character of the papers presented. The total registration was 831, which was double that of any other meeting of the association. The entertainment features were especially fine, and were favorably commented on by those who enjoyed the hospitality of the local committee. Tuesday evening was devoted to a theatre party, the local committee having engaged the entire orchestra floor of Keith's theatre for the use of the foundrymen and their guests. The entertainment was most enjoyable, and the interest of the occasion was heightened by a number of hits being made at prominent members of the association by the artists.



INTERIOR OF CENTRAL ARMORY, CLEVELAND, AS ARRANGED FOR CONVENTION.

Wednesday Morning Session.

The third session of the convention was called to order in the Central Armory about 10:30. The first paper read was by E. M. Taylor, of Boston, and was entitled "Correct Application of True Burden to Iron Costs." In the absence of Mr. Taylor the paper was read by Mr. T. E. Crawford of the Library Bureau, Boston. An abstract of this paper will be published in an early issue of THE IRON TRADE REVIEW. A paper entitled "The Electric Crane in the Foundry" by Harry Sawyer, was read by the title only. This paper will be found in another column of this issue.

Following Mr. Sawyer's paper Mr. W. H. Parry presented his paper entitled "Dark Secrets in Foundry Practice." Mr. Parry is not a practical foundryman and discussed problems of the foundry from the standpoint of an outsider. He incidentally described the use of diamonds for cutting tools, the diamond being inserted in a steel holder and used as a lathe tool. While the cost of the diamond was much higher than that of a steel tool, the saving in time of sharpening and in wear more than compensated for the extra first expense. Mr. J. F. Webb inquired as to the cost of using diamonds for cutting tools and Mr. Parry replied that it was about $8.00 to $12.00 per carat. The stones, however, did not need to be sharpened once in six months. The method of preparing the tool was to make a hole in the steel holder in which the diamond was loosely fitted, and then brass solder was poured around it. The stone was sometimes ground before being placed in the holder and sometimes afterwards. Diamond dust was used for grinding and cost from $6.00 to $8.00 per carat.

Mr. James F. Webb next presented his paper on "Multiple Molds," on which there was no discussion. An abstract of this paper will be published in an early issue of THE IRON

TRADE REVIEW. Following Mr. Webb's paper Mr. Ralph H. West read a paper entitled "Comparative Design and Working of Air Furnaces."

President West suggested that, as the paper was of great importance and the amount of time so limited, discussion be postponed until the next session, and then called upon Mr. N. W. Shed to read his paper entitled "Foundry Fluxes." The paper was discussed by a number of gentlemen, the first being Mr. G. M. Thrasher Jr., chemist of Western Tube Co., Kewanee, Ill. Mr. Thrasher described the conditions under which a cupola at the Western Tube Co. was run for eleven hours per day. The flux used was composed of 35 pounds of limestone and 15 pounds of fluorspar to each ton of iron. The amount of coke used was 300 pounds per ton of iron. They found that limestone alone was not adapted to long heats, such as the above, and that the fluorspar was necessary.

Mr. J. F. Webb told of the troubles of a foundryman who charged, in a 54-inch cupola, 7,000 pounds of iron to 1,800 pounds of coke. After the first couple of tons of iron came down it ran cold and Mr. Webb inquired the reason. Mr. Shed, the author of the paper, said that he thought that too much iron was used for the amount of coke charged, and that not over 5,000 pounds should be used with that amount of coke. Dr. Moldenke agreed with Mr. Shed that the amount of iron was too great, and said that not over 6,000 pounds should be charged.

Mr. A. M. Loudon told of his experiences with the "Jumbo" cupola at Port Chester, N. Y., which ran continuously from 11 o'clock in the morning to 5 o'clock in the evening. Buggy ladles were used and the cupola was tapped from two holes alternately. The slag ran continuously. At 2 p. m. they stopped pouring the soil pipe fittings and went on stove plates. A trolley system was used for this work and there was a continuous line of men obtaining metal from the cupola. The flux used under these conditions was 60 pounds of limestone to the ton. They found that a charge of 7,500 pounds of iron gave the best results. Experiments had been tried from time to time in reducing the amount of flux and it had sometimes been brought down as low as 45 pounds of limestone to the ton. Under these conditions, however, the holes almost became stopped up and it was necessary to increase the charge of limestone at once in order to remedy matters. They had never used a flux on the first two charges of iron.

THE MONARCH ENGINEERING CO.'S EXHIBIT.

SOME CHISHOLM & MOORE HOISTS.

Wednesday Afternoon.

In the afternoon of Wednesday the members and guests took cars at the Hollenden at 1 o'clock, which conveyed them first to the plant of the Brown-Hoisting Machinery Co., and then to that of the Welman-Seaver-Morgan Co., and the Electric Controller & Supply Co. They were entertained at these works, after which the street cars conveyed them to the Case School of Applied Science, where a session was held in the lecture hall of the Electricity building. Prof. C. H. Benjamin, of Case School, gave an illustrated lecture, describing the tests which had been conducted by him on the strength of cast iron during the past ten years.

These tests consisted in the subjecting of cylinders to hydraulic pressure until they burst; the subjecting of plates to hydraulic pressure and to concentrated loads at one point; the testing to destruction of various cast iron beam sections; and the testing to destruction of cast iron fly wheels and pulleys of various forms.

The lecture was illustrated with lantern slides and Prof. Benjamin pointed out numerous things which had been learned in the course of experiments. For instance, he found that in making a cylinder with flanges heavy enough to provide the requisite strength, blow holes would develop at the junction of the flange and cylinder. These weakened it so that the cylinder always failed, when the flange was to any great degree heavier than the cylinder wall, around the circumference of the cylinder immediately below the flange. In the course of the experiments he developed a cylinder in which both wall and flanges were

EXHIBIT OF THOMAS W. PANGBORN CO.

of uniform thickness, the requisite strength being provided by ribs joining the flange and the cylinder. These cylinders on testing failed in the manner that they theoreticaly should: namely, in a straight line parallel to the axis.

Another interesting experiment carried on by Prof. Benjamin was the examination of breaking strength of gear teeth. The gear tooth was placed in a testing machine and broken by applied pressure. It was found that the breaking strength was very close to that calculated by formulae, and that the tooth always failed on a line parallel to the direction of the applied pressure. The strongest form of tooth was found by these experiments, to be the involute rack tooth. In general the involute tooth was much stronger than the epicyloidal.

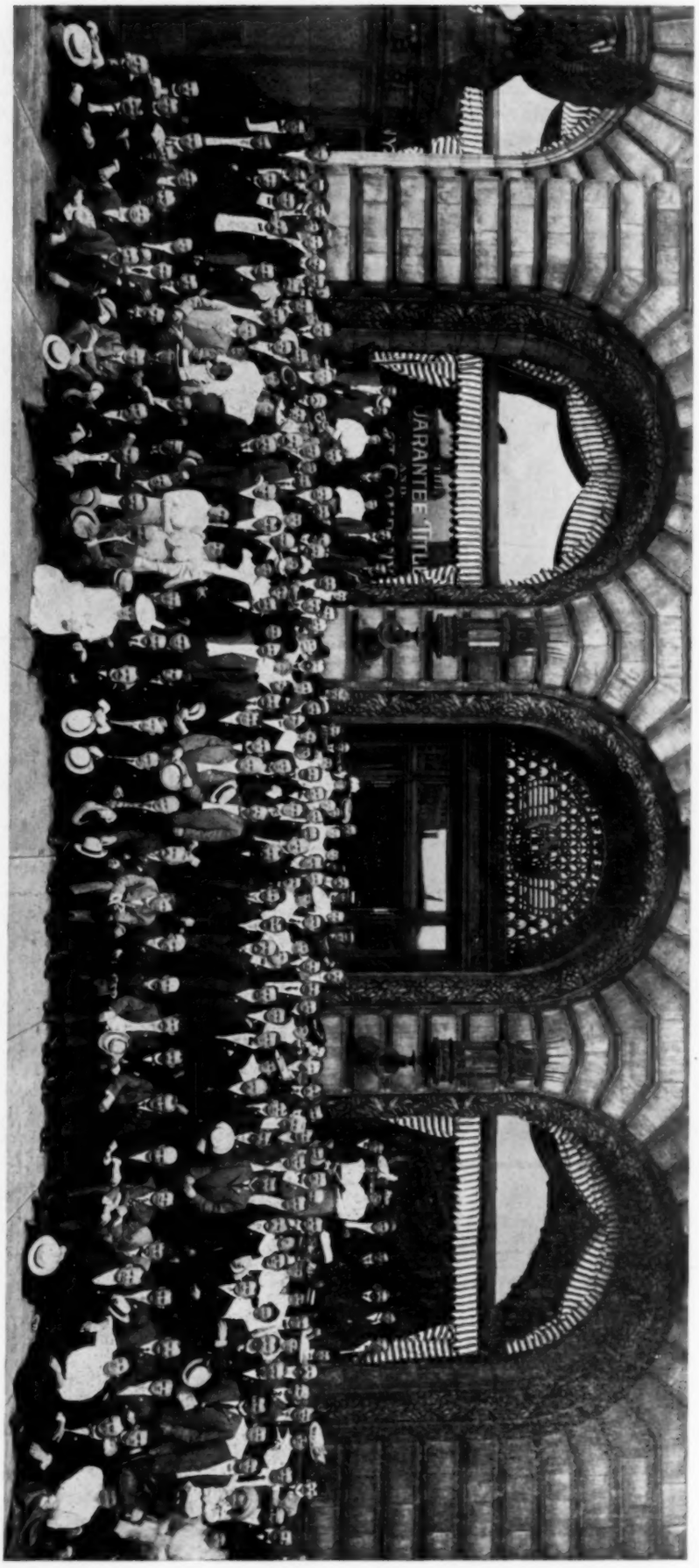
The most interesting series of experiments conducted by the professor was the testing of wheels and pulleys to destruction. The pulleys were placed in a steel casing and driven by a steam turbine up to any necessary speed for breaking. The terrific effects of the bursting fly wheel were illustrated by a photograph of the testing apparatus after it had been demolished by a particularly heavy wheel. The casing was constructed of 1¼-inch boiler plate strongly bolted, with a lining of 12-inch oak blocks. The bursting fly wheel completely demolished the casing, throwing the upper half something over 150 feet away and another portion of it on the roof of one of the buildings. The 1¼-inch boiler plate had broken clean off by the impact.

At the conclusion of the lecture the society tendered a vote of thanks to Prof. Benjamin. In the evening the members and guests of the society visited Luna park, one of the amusement places of Cleveland, in a body.

Thursday Morning Session.

The concluding session of the meeting was held Thursday morning in the course of a boat ride to Lorain, O. About 450 members and guests went aboard the steamer, "City of the Straits," at 9 o'clock Thursday morning and were conveyed to the works of the National Tube Co. at Lorain, 27 miles distant. During the trip, a meeting was called to order in the saloon of the vessel, and Mr. George M. Loudon read a paper entitled "Core Mixtures and Compounds." This paper dealt with 18 tests made by Mr. Loudon on cores made of various proportions of sand and compound, and with a number of different binders and compounds. Mr. Loudon's conclusions

MEMBERS AND GUESTS OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION AT CLEVELAND.



were interesting, as they gave the best proportions and binders for use in cores for different services and of different sizes. There was no discussion on the paper. Dr. Moldenke then moved that all the other papers submitted at the convention be read by title and the discussion dispensed with. This was agreed to and the convention proceeded to the transaction of general business.

The first business was the election of officers. The nominating committee reported the following nominations for officers to serve for the year 1906-1907:

President, W. H. McFadden, Mackintosh, Hemphill & Co., Pittsburg.

Vice president, first division, New England, C. J. Cayley, Russell & Erwin Mfg. Co., New Britain, Conn.

Vice president, second division, New York and New Jersey, John W. Burr, Brook & Houston Co., Brooklyn, New York.

Vice president, third division, Pennsylvania, Stanley C. Flagg Jr., Philadelphia.

Vice president, fourth division, Ohio and Illinois, J. H. Whiting, Whiting Foundry Equipment Co., Chicago.

Vice president, fifth division, Michigan, W. J. Keep, Michigan Stove Co., Detroit.

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Vice president, Sixth division, Wisconsin, Thomas J. Sherriffs, Sherriffs Mfg. Co., Milwaukee.

Vice president, seventh division, the South, J. B. Golden, Golden Foundry & Machine Co., Columbus, Ga.

Vice president, eighth division, Canada, L. L. Anthes, Toronto Foundry & Machine Co., Ltd., Toronto, Ont.

Secretary-Treasurer Richard Moldenke, Watchung, N. J.

The nominating committee recommended that all section officers be appointed by the executive board of the association. On motion, the report of the committee was received and the secretary instructed to cast one ballot for all nominees who were then declared elected.

Mr. H. M. Lane then moved that the organization committee of the American Foundrymen's Supply Association, which was formed at this convention, as related in another column, be made a supplementary committee of the American Foundrymen's Association, and this motion also was adopted.

Mr. J. G. Seaman, of Pittsburg, then stated that it had been the custom of the society to elect the retiring president to honorary membership in the association, and he therefore moved that Mr. Thomas D. West be so elected. The motion was carried by acclamation.

Dr. Moldenke spoke of the growth of the brass foundry business in the country, and stated that the need for an association of brass foundrymen was becoming greater each year, that while the American Foundrymen's Association welcomed all men engaged in the foundry business, he thought that the work of the brass founders could best be carried on by an organization devoted entirely to that purpose. He, therefore, moved that a committee be appointed to consider the formation of an American Brass Founders' Association with instructions to report at the next convention. The motion was carried, and a committee consisting of Mr. C. J. Cay-

ley and Dr. Moldenke was appointed. Dr. Moldenke also moved that a committee be appointed with Mr. J. S. Webb as chairman to study the use of nickel in cast iron and report at the next convention.

Mr. J. G. Seaman arose to express the appreciation of the society for the work of Dr. Moldenke in improving the organization and membership of the association, and in raising it to the high plane which it now occupies. He stated that the present position of the society was almost solely due to the doctor's work, and that he had been untiring in his efforts. He therefore moved a vote of thanks to the doctor. The motion was unanimously carried by a rising vote.

Dr. Moldenke responded in a few well chosen words, in which he expressed his appreciation of the spirit manifested toward him by the association. He stated that the American Foundrymen's Association was his best work, and that he thoroughly enjoyed working for it. For the past 10 or 15 years, he had devoted his entire time to it and had hardly spent an evening in pleasure with his family. It gratified him exceedingly to learn that the society appreciated what little he had been able to do for it.

Mr. A. D. Belden, of the United States geological survey, then addressed the association briefly, and described the coke making experiments at the St. Louis coal testing plant. He stated that little or no investigation had been carried on regarding the subject of coke making. This was due to the fact that nature had provided a splendid grade of coking coal at Connellsville, which requires little or no attention while it was being reduced to coke. The present investigation was being carried on to determine the best methods of manufacturing foundry coke from the many bituminous fields of the United States. In the near future, a partial report will be published of the progress made, and later on, a complete report of the work done will be forthcoming.

An invitation was received from the Philadelphia Foundrymen's Association to hold the next convention in Philadelphia. As the selection of the place of meeting is vested in the executive board, the association passed a resolution recommending that the executive board select Philadelphia as the next place of meeting.

Mr. Field offered a motion tendering votes of thanks to the retiring officers of the association for the efficient administration which they had given it; to the authors of the various papers presented at the meeting; to the local committee for the splendid entertainment provided, mentioning especially in this connection, Mr. H. M. Lane, who has been untiring in his efforts and to whom the success of the meeting and the exhibits was largely due; and to the Philadelphia Foundrymen's Association for its invitation for 1907. The motion was unanimously carried.

Mr. Kenneth Falconer, speaking on a uniform method of cost finding, embodied the substance of his report in a motion to submit to a committee of two or three, which should report at the next convention, the question of a method of uniform cost finding applicable to the foundry business, and that members be requested to submit to this committee any suggestions which might be available. The motion was carried and the meeting then adjourned.

At the close of the meeting, luncheon was served on board of the boat, and by the time it was over, the party had arrived at Lorain. The association disembarked and went through a portion of the plant of the National Tube Works, visiting the Hulett electric ore unloaders, the blast furnaces, power plant and foundry. About two hours were spent on shore and the party then re-embarked and were brought back to Cleveland, reaching town at about 4:30. During the return trip, a meeting of the newly organized American Foundrymen's Supply Association was held, as described on another page of this issue. On its arrival in Cleveland, the association and its guests proceeded to the steps of the Chamber of Commerce where the photo-

C. J. CALEY.

JOHN HILL WHITING.

L. L. ANTHES.

SOME OF THE NEW VICE PRESIDENTS.

JOHN W. BURR.

graph shown in connection with this report was taken.

Thursday evening was devoted to a smoker held in the Central Armory, which was attended by about 600 persons. A vaudeville entertainment was provided which was thoroughly enjoyed by all present. Liquid refreshments was drawn from one of the cupolas in the exhibition and served by waiters with long-handled foundry ladles. Each person in attendance at the smoker was provided with "molders' tools," consisting of a souvenir stein, a corn cob pipe and a pouch of tobacco. The Falls Rivet & Machine Co. also presented each person in attendance with a leather case containing "sample cores," which were stated to have been made on a Wadsworth improved core machine. The cores were all cigar shaped, were made of a very fine quality of tobacco, and were put to their proper use by all present. Considerable amusement was furnished by the local committee passing a number of cigars with concealed springs in them which let go and threw the tobacco around after the cigar had burned a certain distance. The assemblage broke up about 10:30, everyone saying that the convention was one of the most enjoyable in the history of the association.

THE EXHIBITS AT THE CONVENTION.

(WRITTEN FOR THE IRON TRADE REVIEW BY W. J. KEEP.)

The local management had arranged to have the sessions in the center of the large drill room of the Central Armory while the rest of the space

THE EXHIBIT OF THE OSBORN MFG. CO.

THE EXHIBIT OF THE J. D. SMITH FOUNDRY & SUPPLY CO.

portant position in foundry work of the future was evident to all. Electricity makes it practicable to operate any machine at such a show, but the Bruce-Merriam-Abbott Co., Cleveland, O., installed one of its 55-horsepower gas engines which furnished power for the exhibition through line shafting, and by compressed air.

This firm makes gas engines from three to 100 horsepower. There is an ignition at each stroke, but the governor regulates the gas used so as to produce a uniform speed with any load. What drew many to the exhibition was the

Molding Machine in Operation

and this exhibit was most satisfactory. There is no question but machine molding is to revolutionize foundry business. While the molders' union professes a willingness to have its members run machines and bring out all that the machine is capable of doing, yet the fact is that owing to influences that they are able to control the machine has not been a success in a union shop and probably never will be. Laborers are the only men who are willing to turn out the maximum amount of machine work and the attitude of the union will of necessity make open shops of all who can make their work by machine. In the near future a simple machine will be made that will print work and a quick cheap way to put work on match plates will be devised, and then the stove shops

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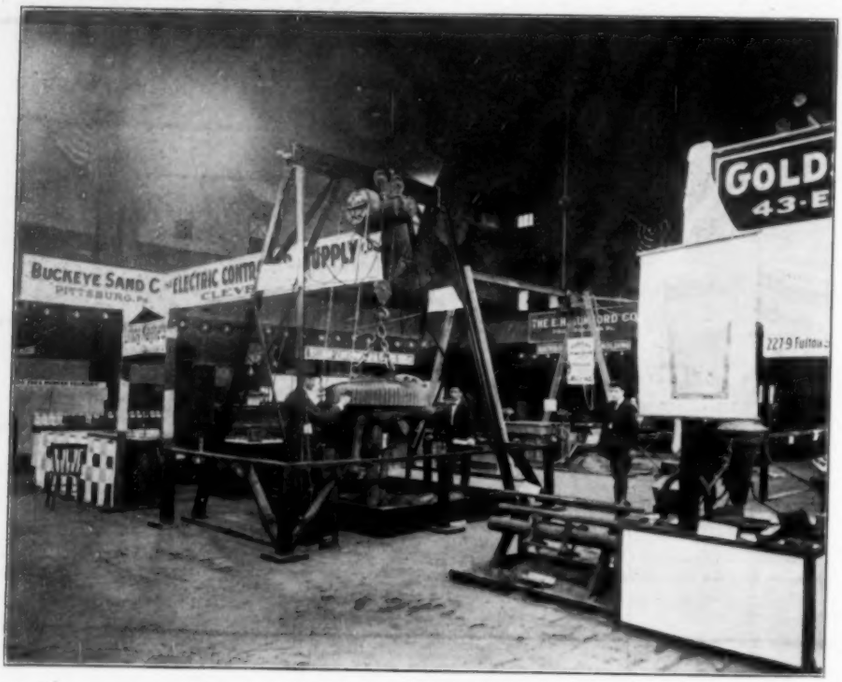
The bounties paid by the Canadian government on steel and iron last year amounted in all to $1,540,203. The Dominion Iron & Steel Co. received $674,880, the Algoma Steel Co., $404,900 and the Nova Scotia Steel Co., $125,768.

was used to exhibit foundry appliances. The latter proved so interesting that after the first meeting the committee withdrew to other quarters and the Armory became a foundry appliances exhibition.

That machinery was to take an im-

will drop from the union into the open shop ranks. There is no chance that the union will grasp the condition until it is too late.

The "Modern" molding machine of the Arcade Mfg. Co., Fairport, Ill., is a hand operated machine which runs cape and nowel at one motion and can take in a large variety of shapes and sizes of work. It draws the patterns upward and while at present it will not print work, it seems as though a slight change would do it. Its method of making match plates is very simple and practical. The statement shows that one man shoveling his own sand from the heap has made and poured 275 molds per day of seven hours in a 11 x 16 flask, taking something like 1,200 pounds of melted iron.

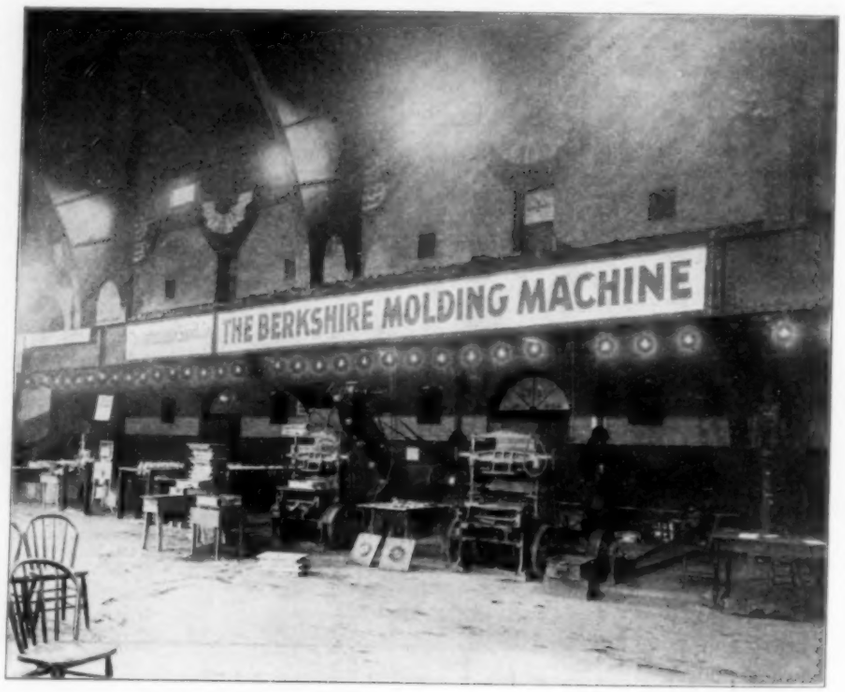


THE ELECTRIC CONTROLLER & SUPPLY CO.'S EXHIBIT.

The Berkshire Mfg. Co. of Cleveland had in operation a power machine which with one laborer at the machine, one shoveling sand and one to carry away the flask, could turn out one mold per minute and the three men would pour the work. Taking the union rule of seven hours' molding, this gives an average of 140 molds per man, which is about twice as much as a union molder would do by hand.

The J. D. Smith Foundry Supply Co., Cleveland, exhibited the Cleveland molding machine which was attached to a post which could be adjusted to varying work in very short time.

The E. H. Mumford Co. of Philadelphia, operated by compressed air three types of its machines. They make seven types. These machines had vertical vibrations and have many modern improvements. The Rathbone multiple molding machine made stacks of molds nine high, giving three times the output and a saving of 88 per cent of floor space and 37 per cent in sand and flasks. The sand is forced upward among the patterns with such force as to ram the deepest corners as perfectly as if the sand had been dropped on the pattern from a considerable height. The company guarantees one mold per minute when the man shovels his own sand from the heap.



BERKSHIRE MOLDING MACHINES AT FOUNDRYMEN'S CONVENTION.

A full description of this machine was given in a paper before the convention by Mr. Mumford.

The Tabor Mfg. Co. of Philadelphia, Pa., had in operation power and hand ramming vibrating molding machines all operated by compressed air. One 24-inch Faber hinged machine, with seven-inch straight draft, rolls along with the sand heap. A 14 x 16 split pattern machine was making fittings. The company also exhibited a 13-inch cylinder 36-inch spread machine.

The Tabor Mfg. Co. also exhibited the Taylor-Newbold saw for cutting steel.

The Herman Pneumatic Machine Co., of Zelienople, Pa., operated a heavy molding machine which undertakes work too large for any other machine to handle. The pattern is fitted to a bed plate on which the flask is placed and on this a hopper some 12 inches high. These are filled with sand and by compressed air the whole is lifted and let drop onto the foundation, giving a jar that packs the sand into the deepest parts of the mold. From 20 to 40 drops gives the required hardness to the mold. Removing the hopper and striking off the surface of sand completes that half of the mold.

The Sand Exhibit

was a revelation. Natural molding sands from various localities were exhibited, also silica sands. As sand becomes more scarce, more attention

is paid to mixing and preparing sand to met the various requirements of the founder.

The Standard Sand & Machine Co., of Cleveland, had in operation various machines for preparing sand of any grade such as mixers, screens, pulverizers, elevators and tempering machines. It claims to make a much better product than nature has produced.

The American Sand Co., Columbus, O., had on exhibition eight grades of silica sand, three grades of ground ganister and nine grades of Zanesville sand.

The Buckeye Sand Co., Pittsburg, had 23 grades comprising steel, silica, lake and molding sands.

The Interstate Sand Co., Cleveland, exhibited all grades of sand from Zanesville and Conneaut and Tuscarawas regions, also silica sands. It also mixes and prepares sands of all grades and for all purposes.

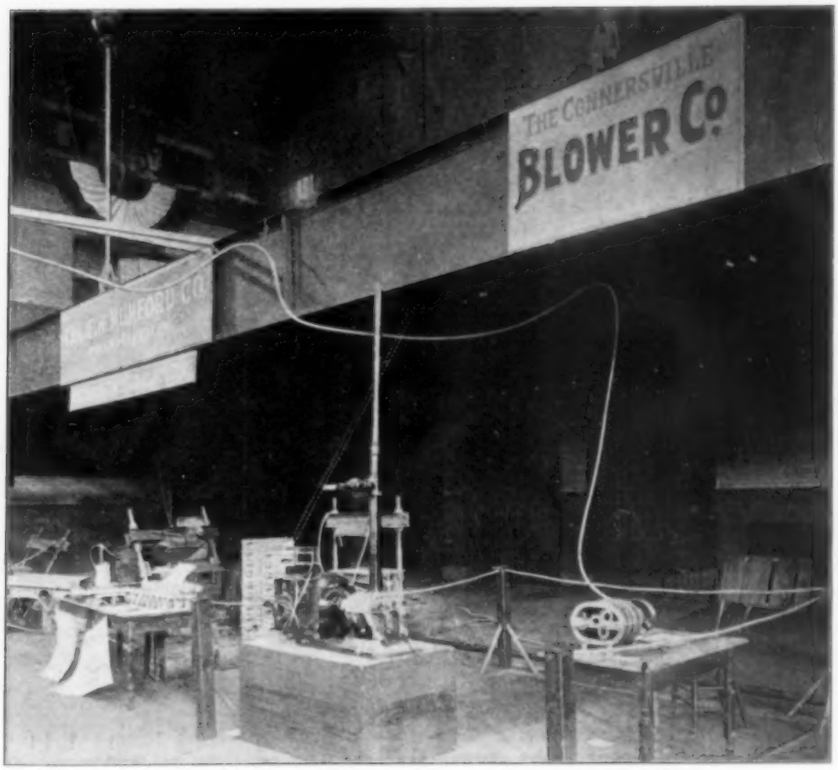
The Cleaning of Castings.

The W. W. Sly Mfg. Co., of Cleveland, has devoted itself to making machinery for this purpose and had in operation the Sly water cinder mill, the Sly suction mills, which are better than any other mill that we are acquainted with, and are said to take less power on acount of their peculiar construction.

The Sly dust arrester takes the air from the cleaning room and removes all dust. One user states that the air could be returned over your desk without soiling your writing paper.

Under this head were the E. A. Dempwolf & Sons of York, Pa., with an exhibit of hydrofluoric acid.

THE TABOR MFG. CO. AND THE CHICAGO PNEUMATIC TOOL CO.



EXHIBITS OF THE E. H. MUMFORD CO. AND THE CONNERSVILLE BLOWER CO.

Core Making Machines and Core Compounds.

The Falls Rivet & Machine Co., Cuyahoga Falls, O., had in operation Wadsworth core making machine, core oven, coring machines and all core room equipments.

The Buckeye Milling Co., Cleveland, exhibited Cleveland dry core compound and Wago core binder.

The Holland Linseed Oil Co. of Chicago had samples of small and large cores made with its liquid core compounds.

Fans and Pressure Blowers.

The B. F. Sturtevant Co. of Boston, exhibited centrifugal fans, also a new type of high pressure blower was shown by a full sized working model in motion. In addition it exhibited a line of belting and foundry supplies and Cortland corundum wheels sold by S. C. Cutler at Cleveland.

The Connersville Blower Co. of Connersville, Ind., had in motion a pressure blower and the same was shown in section.

Fluxes.

Fluxes were shown by the Western Foundry Supply Co. of East St. Louis, Ill., which had samples of ground 80 per cent ferro-manganese to use in the foundry ladle to prevent blowholes, increase strength, to remove sulphur and make soft castings.

The Crystal Fluorspar Mining Co., Cleveland, exhibited Empire foundry flux.

Foundry Supplies.

These were represented by the Osborne Mfg. Co., Cleveland, which exhibited a very complete line of brushes and tools for the foundry. This company is furnishing a revolving brush for cleaning castings which has given general satisfaction.

The J. D. Smith Foundry Supply Co., Cleveland, exhibited drawings for a

model foundry and had a full assortment of foundry supplies and of foundry equipments, standard brass furnace, pneumatic riddles, and a water tumbler for polishing brass castings.

The Detroit Foundry Supply Co., Detroit, Mich., concentrated all its efforts on its newly patented Galvarim riddle, a new departure in riddles, the rim being made of galvanized iron, top and bottom turned over 3-16-inch iron, a groove in the lower edge holding the removable wire bottom which can be replaced when worn out.

THE GOLDSCHMIDT THERMIT CO.'S EXHIBIT.

The Miscellaneous Exhibits.

Goldschmidt Thermit Co. of New York, gave frequent demonstrations of the use of thermit in foundry operations. A small portion placed in a ladle of molten iron or steel that is too dull to pour at once heats it and renders it fluid enough to fill the mold. For mending broken machines or welding rods and shafts it is very convenient.

The Chicago Pneumatic Tool Co. of Chicago, exhibited a full line of appliances for foundry work such as the air compressor which supplied the whole exhibit with compressed air, sand rammers, chippers, drills and sand sifters.

The Wellman-Seaver-Morgan Co. of Cleveland, builder of iron and steel foundries, had drawings of its own foundry and of others.

The Cleveland Wire Spring Co. of Cleveland, exhibited a steel barrel which was far superior to any wooden barrel and showed a truck for handling it.

The Steele-Harvey crucible furnace by the Monarch Engineering Co., Baltimore, Md., to be used with natural gas or with oil attracted much attention.

The Atlas Car Mfg. Co. of Cleveland, had industrial tracks and flexible wheelbase cars.

The White Tool & Supply Co. of Cleveland, had a very full display of equipment for the wood pattern shop and for the polishing room, also emery and corundum wheels.

EXHIBIT OF THE WHITE TOOL & SUPPLY CO. AND THE CRESCENT MACHINE CO.

The Electric Controller & Supply Co., Cleveland, exhibited in addition to regular controllers a lifting magnet for pig iron.

Thos. W. Pangborn Co., New York, exhibited sand blast apparatus.

The Diamond Clamp Flask Co. of Richmond, Ind., exhibited the Gartside Universal angle coupling with which a shaft can turn a corner. It also had core machines and belt shifters.

W. W. Lindsay & Co., Philadelphia, had a full exhibit of chaplets and anchors.

The Harbison-Walker Refractories Co., Pittsburg, had a display of fire brick and fire clay.

The Chisholm & Moore Mfg. Co., Cleveland, had a full display of chain hoists and trolleys.

The Whiting Foundry Equipment Co., Chicago, exhibited one of its improved cupolas.

Wm. Dobson, Canastota, N. Y., exhibited over 300 different working tools used by molders.

The Colonial Varnish Co., Cleveland, exhibited wood stains.

I wished to give a description of the exhibits at this first Foundry Appliances Exhibition to show what might have been done if the exhibits had come from all over the country and to show that instead of an exhibit of old-time foundry suply materials it was in reality an exhibit of machinery in the foundry. There is an opening for this higher and broader class of exhibition to be held in conjunction with the annual conventions of foundries whom the exhibitors wish to meet. Every founder could afford to send his superintendent and foreman to such a show.

COLLAPSING PRESSURES OF BESSEMER STEEL LAP-WELDED TUBES FROM 3 TO 10 INCHES IN DIAMETER.[1]

BY REID T. STEWART.[2]

Note:—At the request of Prof. Stewart, the publication of this paper was withheld until it had been revised by him. The paper as presented at the Chattanooga meeting, contained many inaccuracies both in the formulae and drawings. The manuscript of this abstract has been revised by Prof. Stewart, and the article may therefore be taken as absolutely correct.—Editor.]

The planning and execution of this research was rendered especially difficult because of the lack of any reliable data bearing upon the behavior of modern wrought tubes when subjected to a fluid collapsing pressure. Fairbairn's experiments made more than a century ago on tubes unlike the modern product were of such a character as not to furnish any suitable data for the planning of a similar but much more elaborate research on modern tubes. While planning this research, it was assumed that the resistance offered by the tubes to the external fluid pressure would depend upon the following five things: (1.) The diameter of the tube. (2.) The length of tube between transverse joints, or end connections tending to hold it to a circular form. (3.) The thickness of wall. (4.) The deviation of the tube from perfect roundness. (5.) The physical properties of the material, of which the tube is made. Of these five things that may vary, it was thought that, for the preliminary experiments, at least, 4 and 5 would be practically constant; 4, because the tubes being all made by the same process would probably run fairly uniform as to deviation from roundness; 5, because the material in this case is known to run fairly uniform in its physical properties. The only variation, therefore, to be expected in 4 and 5 would be that due to the inability of the manufacturer to turn out a uniform product. It is recognized that the physical properties of rolled steel depend, in some measure, upon the thickness of the wall of the tube, and any variation will be a function of the thickness and consequently will be taken care of in an empirical formula by the quantity representing the thickness. All published formulae indicated that the diameter and thickness of wall have each an important influence on the collapsing pressure of the tube, and it was decided to plan the research to discover, if possible, the precise nature of this influence over a wide commercial range.

The influence of the length of tube between transverse joints, or end connections tending to hold it to a cir-

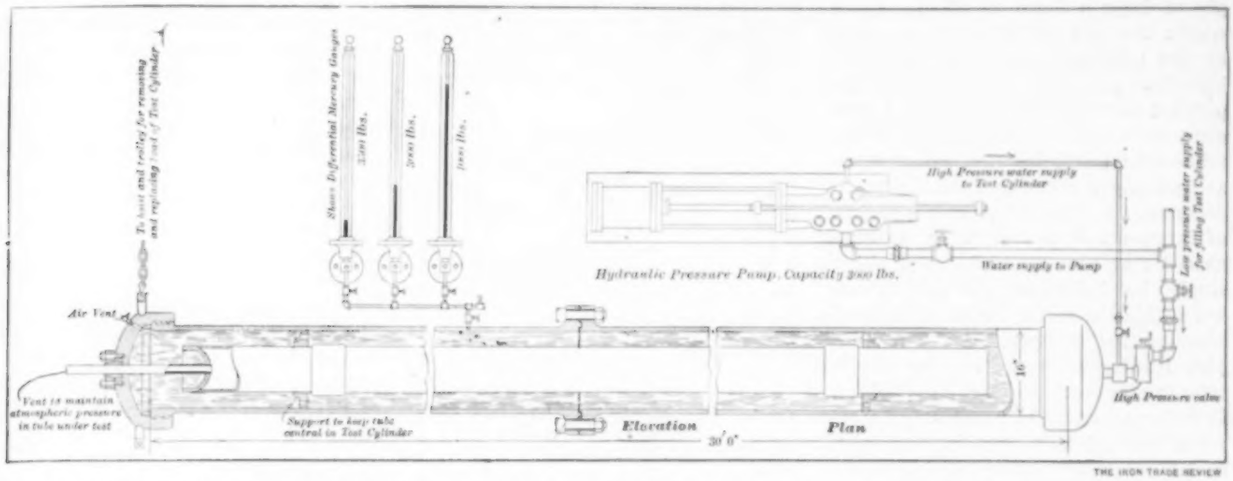

Air Vent
Vent to maintain atmospheric pressure in tube under test
Support to keep tube central in Test Cylinder
Elevation
Plan
30' 0"
16"
Hydraulic Pressure Pump. Capacity 300 lbs.
High Pressure water supply to Test Cylinder
Water supply to Pump
Low pressure water supply for filling Test Cylinder
High Pressure valve
THE IRON TRADE REVIEW

FIG. 1.—16-INCH HYDRAULIC TEST APPARATUS FOR CONDUCTING COLLAPSING TESTS ON BESSEMER STEEL LAP-WELDED TUBES.

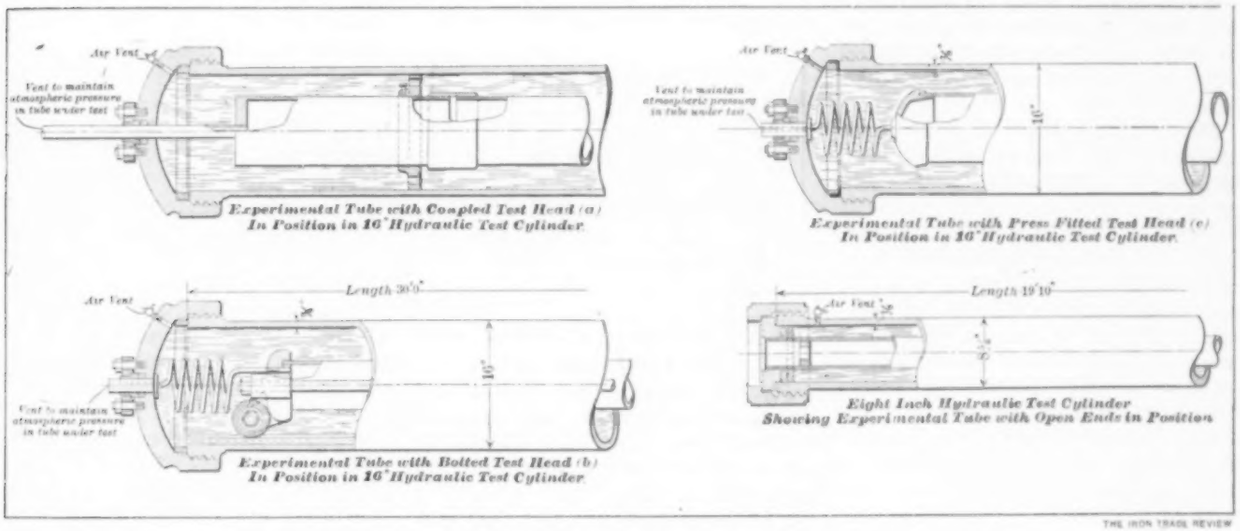

Air Vent
Vent to maintain atmospheric pressure in tube under test
Experimental Tube with Coupled Test Head (a) In Position in 16" Hydraulic Test Cylinder
Experimental Tube with Press Fitted Test Head (c) In Position in 16" Hydraulic Test Cylinder
Length 30'0"
16"
Experimental Tube with Bolted Test Head (b) In Position in 16" Hydraulic Test Cylinder
Length 19'10"
Eight Inch Hydraulic Test Cylinder Showing Experimental Tube with Open Ends in Position
THE IRON TRADE REVIEW

FIG. 2.—HYDRAULIC TEST CYLINDERS SHOWING EXPERIMENTAL TUBES IN POSITION.

[1] Abstract of a paper presented at the Chattanooga meeting (May, 1906) of the American Society of Mechanical Engineers.

[2] Professor of Mechanical Engineering, Western University, Allegheny, Pa.

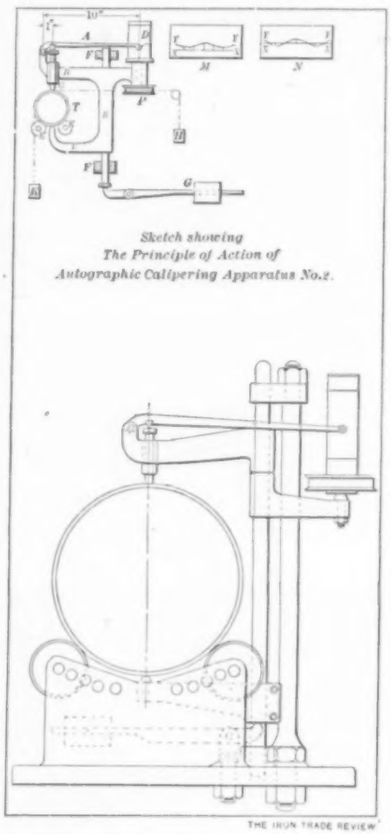
cular form, upon the collapsing pressure, appeared to be the most uncertain of all variables entering the problem. It was decided, first of all, to determine the precise nature of this influence. The following apparatus was used for this purpose.

Hydraulic Test Apparatus.

The apparatus used is shown in Fig. 1. The scheme provides for: 1. A test cylinder with one head removable for the reception of the tube to be tested. 2. A low pressure water supply of large volume to fill the space within the test cylinder not occupied by the tube under test. 3. A variable high pressure water supply, the purpose of which was to create a fluid pressure within the test cylinder, the tube under test being thus subjected to a gradually increasing fluid collapsing pressure. 4. A set of pressure gauges, of large range and capacity, so connected that they could be used either singly for indicating the fluid pressure within the test cylinder, or in combination for comparison. 5. A vent pipe leading from the interior of the tube under test to the atmosphere, in order to maintain constantly an atmospheric pressure within the tube. 6. An air vent connecting with the highest point of the interior of the test cylinder, in order to thoroughly free from air the interior of the test cylinder, while being filled with water, after the insertion of the tube to be tested.

Sixteen-Inch Test Cylinder.—This cylinder was constructed of two sections of aggregate length of about 30 feet. The sections of the test cylinder were made from Bessemer steel, lap-welded tubes, 16 inches outside diameter and ¾ inch thick, to which steel flanges were welded for the intermediate joints. The highest fluid pressure reached in this test cylinder was a pressure of 2,890 pounds per square inch in the wall of the cylinder. The heads for the 16-inch cylinder were made from circular blanks punched from 2½-inch steel plates and hot pressed into shape. They were then fitted to the ends of the test cylinder, by means of trapezoidal threads, designed to best resist stress in one direction. The flange joints connecting the different sections of the test cylinder were tongued and grooved, and made up with leather packing in the bottom of the grooves. The joints each contained eighteen 1¾-inch steel bolts.

The cylinders were first filled from the low pressure water supply, and then the hydraulic pressure within the test cylinder was created by means of an hydraulic pressure pump, which was capable of working against a fluid pressure up to 3,000 pounds per square inch. The pump was ordinarily operated upon entering the region of expected collapse, so as to increase the fluid pressure at a rate of about from 2 to 10 pounds per second, depending upon the gauge used. At these rates of increase conditions were favorable for making an exact determination of the fluid pressure under which the tube failed.



Sketch showing The Principle of Action of Autographic Calipering Apparatus No. 2.

FIG. 3.—AUTOGRAPHIC CALIPERING APPARATUS NO 2.

Pressure Gauges.—The gauges used for indicating pressure at instant of collapse, were three Shaw differential-piston mercury gauges, with respective capacities of 1,000, 3,000 and 8,500 pounds per square inch, and were connected, as shown in Fig. 1.

Eight-Inch Test Cylinder.—This cylinder was constructed for testing the 3 and 4-inch tubes, and was made from a single 20-foot length of 8-inch double extra strong pipe, 8⅝ inches outside diameter and ⅞-inch wall. The details of one end of this cylinder, with the tube under test in place, are shown in Fig. 2, the other end being an exact duplicate of the one shown. This apparatus was arranged to permit of the testing of a plain end tube, with the interior tube exposed to view while under test. The tube thus is relieved, while under test, of any longitudinal stress due to the fluid pressure surrounding it. The tube was held in place within the test cylinder by steel centering rings at each end, while cup leather packing rings were slipped in place over the ends of the tube to be tested. The leather packing ring at each end of the tube was backed by a cast iron ring that filled the space between the inner surface of the test cylinder and the tube under test. The latter ring was held in place by means of a steel sleeve engaging its outer surface by means of an internal flange, and which is attached to the end of the test cylinder, by means of trapezoidal threads. A plug was inserted, as shown, near each end of the experimental tubes for the purpose of preventing the centering ring and packing from being damaged and the attendant difficulty of removal of tube that might result from its collapse in the end connections. The smaller test cylinder was placed over and supported by the larger one. It was connected to the same set of pressure gauges, and was operated, in every essential respect, precisely as was the large one.

In order to get a fluid pressure equal to the greatest working capacity of this cylinder, it became necessary to couple up in series two hydraulic pressure pumps, each of 3,000 pounds capacity, so that the second pump could, if desired, deliver water to the test cylinder under fluid pressure up to 6,000 pounds per square inch. The highest pressure attained in the apparatus was 5,625 pounds per square inch.

The coupled test heads, as shown in Figs. 1 and 2, were made up from short lengths of tubing of the same diameter and thickness of wall as that of the tube placed under test. One end of this test head was threaded like the tube under test, and the two connected by means of a standard sleeve coupling, precisely as would be two sections of the same tubing in practice. The other end of each of these test heads was closed by having a steel disc inserted into the end and welded in place, the left hand test head being drilled and tapped for the reception of the vent pipe. This method of closing the ends of the tubes was slow and expensive, and after the discovery that the influence upon the collapsing pressure, due to the tendency of the end connections of the tube to hold it to circular form, ceased to be measurable, for commercial tubes at a distance over a length from either end of from three to four diameters, a less expensive and otherwise more satis-

factory method was used. The bolted test head, shown in Fig. 2, consisted of a casing with a circular groove cut into its face for the reception of the plain end of the experimental tube. Suitable packing was inserted at the bottom of the groove, and produced a water-tight joint, when the head was firmly pressed against the end of the tube. The two through bolts shown were intended merely to hold the two heads in place and prevent leakage at the start of the test. The left hand head was drilled and tapped for the reception of the vent tube.

The press fitted test head was the simplest of all the devices used and consisted of iron castings grooved for the reception of the ends of the experimental tubes. The grooves were close-fitting on the sides and contained packing at the bottom, thus forming a satisfactory joint that became staunch-er as the external fluid pressure upon the tube increased.

The vent pipes for the coupled test head consisted of a 1½-inch straight pipe, one end of which was screwed into the test head of the tube, while the other passed through the end of the hydraulic test cylinder to the external atmosphere. Cup leather packing rings rendered the joint tight against fluid pressure. For the other two styles of head, where the experimental tubes were not necessarily kept central in the cylinder, flexible pipe made by coiling a sufficient length of ½-inch gas-pipe into a helical form, was used.

Autographic Calipering Apparatus.

Two autographic calipering apparatuses were devised, the first of which proved too light for the service required. The construction and operation of the second apparatus are shown in Fig. 3, the tube being calipered was made to rotate by any suitable means on supporting guide wheels EE. The frame BB by means of the guides FF and the counterbalancing lever and weight G, keeps the lower calipering point constantly in contact with the under surface of the tube while it is being made to rotate. Any variation in the length of the vertical diameter of the tube while rotating will cause a motion of the upper calipering point C with respect to the frame BB, which variation is magnified tenfold by the lever A and recorded on the drum D. Motion is communicated from the tube to the record drum by means of a cord weighted at both ends, which passes once around the tube, and the pulley attached to the drum. Two cards taken from the record drum, are shown in Fig. 3, in which the line XX is a reference line made by rotating the drum by hand, while a distance piece, whose length is equal to the nominal outside diameter, is placed between the calipering points. The line YY is produced by rotating the tube between the calipering points in the manner above described. Fig. 4, is a representative example of the numerous autographic records made in connection with this research.

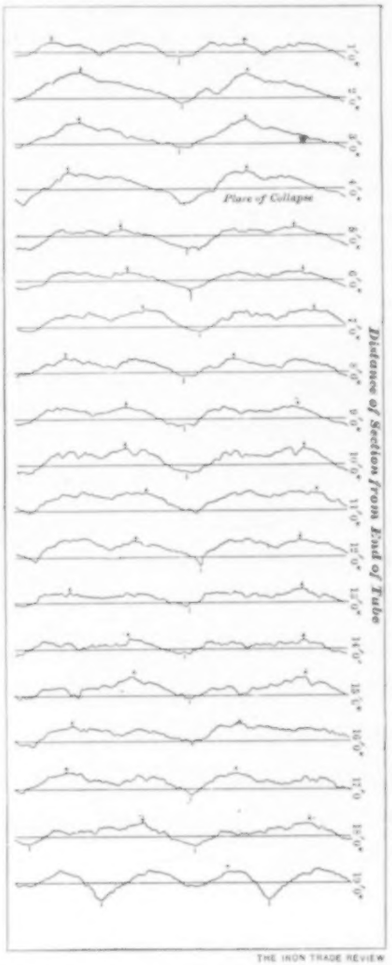


FIG. 4.—RECORDS FROM AUTOGRAPHIC CALIPERING APPARATUS.

Collapsing Tests, Series One, Showing the Influence of Length of Tube on the Collapsing Pressure.

Two series of tests were made, the first being on tubes 8⅝ inches diameter, with all the different commercial thicknesses of wall and in lengths of 2½, 5, 10, 15 and 20 feet between transverse joints. The tubes used in making the tests were obtained in the National department of the National Tube Co., McKeesport, Pa., on orders filled in the usual commercial way, and the tubes, therefore, represented fair samples of the regular product of the mills. The nominal outside diameter of all tubes in series one, is 8.625 inches, and the average outside diameter of the tubes ranged from 8.642 inches to 8.672 inches.

The average outside diameter was determined by measurements on each individual tube, at intervals of one foot along its entire length. The measurements were made with a steel tape graduated to read directly in inches, that is, each inch division on the tape had an actual length of 3.1416 inches. By this means, diameters could be read directly from circumferential measurements, making it possible to obtain by means of a single reading an average of all the different diameters of any particular foot length of the tube.

There were five nominal thicknesses of wall tested in Series One, namely 1.180, 0.229, 0.271 0.281 and 0.322 inch, having nominal weights, respectively, of 16.07, 20.10, 24.38, 25.00 and 28.18 pounds per foot length for the outside diameter of 8⅝ inches. The actual plain end weights per foot corresponding to the nominal thicknesses were respectively 16.23, 20.53, 24.18, 25.04 and 28.55 pounds.

Collapsing Pressure.—In and near the region of expected collapse, the hydraulic pressure within the test cylinder and surrounding the tube under test was increased by a varying rate, with the different series of tubes, the rate ranging from 0.9 pounds per square inch per second to 10.8 pounds per square inch per second. The rate in every case was low enough to permit of making accurate readings of the fluid pressure exerted upon the tube under test, and also to allow for free elastic deformation of the material constituting the walls of the tubes. In no case was the elastic limit of the material exceeded until after failure had actually occurred, since the apparent stress on the wall of the tube at the instant of failure ranged from about 7,000 to 34,000 pounds per square inch, respectively, for the relatively thinnest and thickest walls in Series Two.

Collapsed Portion.—The appearance of the tube after being collapsed in the hydraulic apparatus is clearly shown by the photographs and by the collapsed sections. The photographs of collapsed tubes, taken in conjunction with the collapsed sections, show very clearly the precise nature of the distortion resulting from the subjection of the tube to an external fluid pressure sufficient to cause failure. Referring to Fig. 5, which is a reproduction of the photographs Nos. 50 to 54, inclusive, it will be observed that two views of each tube are shown. One of these was taken looking in the direction of the axis of collapse, the other taken after the tubes were rotated on their supports through an angle of 90 degrees. The tubes were

all calipered for out-of-roundness, at distances of one foot apart along their entire lengths, before being placed in the hydraulic test apparatus. The ends of greatest and least diameters at each of these sections were marked on the tube by means of plus and minus signs, as shown on the photograph. Where the figure 0 appears, the tube was so nearly round as to make it difficult to distinguish a greatest and least diameter at that section even with the exceedingly refined methods in use for making the determination.

The lengths of the collapsed portions of the tubes varied but slightly from six diameters of tube, after suitable corrections were made for the recoil of the test cylinder and the inability to stop the pump instantly.

The angular distance of the point transverse plane, just as readily after distortion as before.

Physical Properties of the Steel.—The physical properties of the steel in each tube were determined, and were the averages from three test specimens cut from each tube after removal from the hydraulic test apparatus, the test-piece, in every case, being cut from the undistorted portion, except in a few cases in Series Two, where these specimens were cut from the distorted portion. In these latter, it should be noted that the yield point is raised and, at the same time, the elongation and reduction of area are lowered, more or less, according as the portion from which the specimens were cut were more or less distorted. The tensile strength ranged from 53,000 to 63,000 pounds per square inch, the

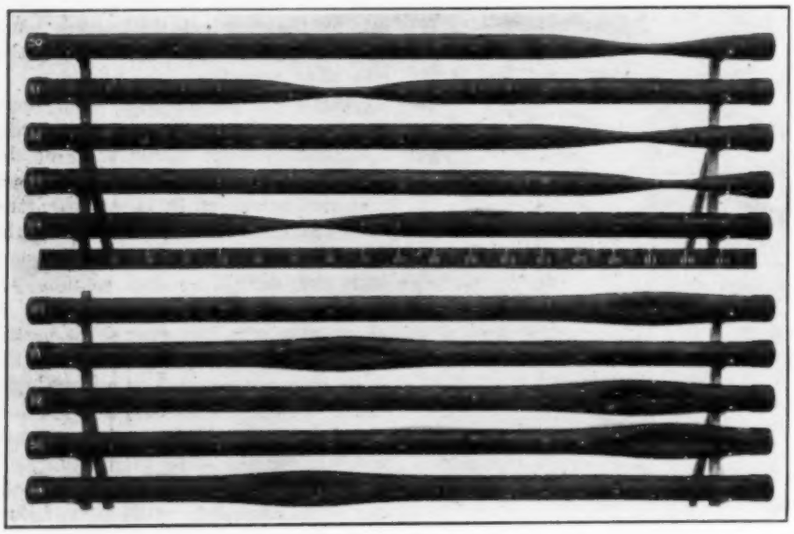


FIG. 5.—SOME OF THE COLLAPSED TUBES.

of collapse from the weld was obtained by measuring the angular distance from the axis of collapse to the weld. Angles measured clockwise were designated plus, and those measured in the opposite direction were designated minus. The figures ranged from —5 degrees to — 173 degrees, and from + 5 degrees to + 165 degrees. In a number of cases, it was zero degrees, and in others 180 degrees, indicating that the failure occurred at the weld or directly opposite it. The angular distances were measured by means of an especially constructed tape, on which distances were laid off equal to the circumference of different sizes of tubes tested. The distances were then divided into 360 equal parts, each of which represented the length of one degree of arc of the circumference. This affords a method of measuring the angular distances between two points on the surface of the tube in the same

yield point in these cases being, respectively, 37,300 and 41,000 pounds per square inch, the elongation 16 and 25 per cent respectively, and the reduction of area 54 and 54 per cent, respectively.

Chemical analyses were made of all tubes, determinations being made of silicon, sulphur, phosphorus, manganese, carbon and oxide. The kind of material, whether Bessemer steel, open-hearth steel or wrought iron, constituting the experimental tubes, was determined for each case by means of the chemical analysis. With few exceptions, the tubes were of Bessemer steel, which showed the following average physical properties:

Tensile strength, pounds per square inch	58,000
Yield point	37,000
Elongation in 8 inches, per cent.	22
Reduction of area, per cent	57

The following is the average chemical analysis:

Sulphur, per cent	0.069
Phosphorus, per cent	0.106
Manganese, per cent	0.350
Carbon, per cent	0.074

Deduction of Law Showing the Relation of Collapsing Pressure to Length of Tube.

In order to arrive at the law expressing the collapsing pressures of Series One in terms of the length of tube and the different thicknesses of wall,

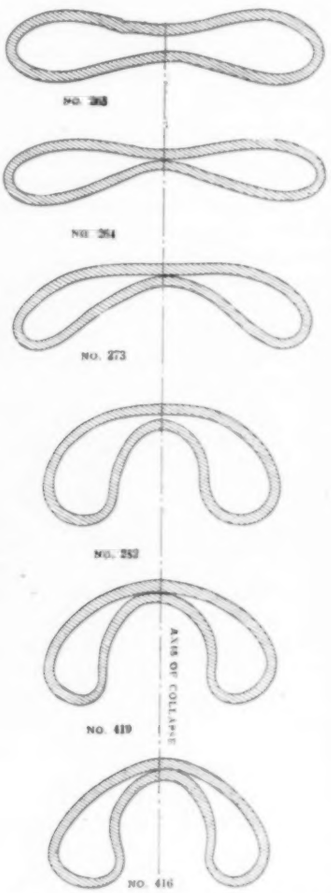


FIG. 6.—COLLAPSED SECTIONS OF TUBES.

for the diameter chosen, it was necessary to rearrange the tests of this series, so that for each of the five lengths of tube tested, the actual average thickness of wall of each experimental tube fell in the group having the nearest nominal thickness of wall.

Collapsing Pressure Corrected to Nominal Thickness.—In order to obtain comparative results, it was necessary to obtain from the observed collapsing pressure of each experimental tube, whose thickness of wall did not exactly equal the nominal thickness, a collapsing pressure which would correspond to this nominal thickness; that is, the observed collapsing pressures corresponding to the respective

thicknesses of wall tested were corrected, so that each would represent what the collapsing pressure would have been had the tube been of the exact nominal thickness instead of that observed. The correction was made graphically by plotting to a vertical scale representing collapsing pressure, and a horizontal scale representing thickness of wall, the results of the tests, for all the different thicknesses of wall for each of the five lengths of tube; second, drawing the mean line representing average results; and third, drawing a line parallel to this mean line through the plotted value for each tube intersecting the ordinate corresponding to the thickness of that tube.

Relation of Collapsing Pressure to Length of Tube.—Relation of collapsing pressure to length of tube is shown in Fig. 7 for 8¼ inch casing (8⅝ inches outside diameter) in the four nominal thicknesses of 0.180, 0.229, 0.271, 0.322 inch, and for lengths of from 2 to 20 feet between the regular couplings. The curves marked "M" were constructed from the different plotted averages of collapsing pressure corrected to nominal thickness. Curves marked "N" were obtained by adjusting the curves M, so as to harmonize with the most probable values for collapsing pressures, as based on Series Two. The curves N are only 5.6 per cent below the corresponding curves M. An inspection of the curves discloses the fact that for 8⅝-inch outside diameter tubes, there is a marked dropping off in collapsing pressure as the length of tube is increased up to 4½ feet, or until a length equal to about six diameters is reached. Beyond this point, there appears to be no further material decrease in collapsing pressure. For example, from curve M, for a thickness of 0.180 inch, the collapsing pressure for lengths of 2, 4½ and 20 feet are, respectively, 1,050, 570 and 480 pounds. As the thickness of wall is increased this disparity between the relative strength of long and short tubes becomes less prominent until for a thickness of 0.322 inch the difference is so small as to be of no practical importance.

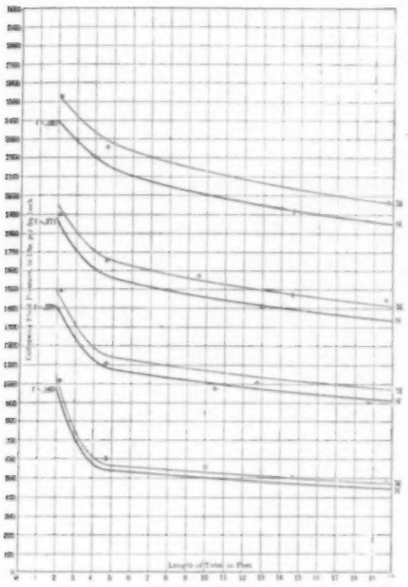


FIG. 7.—CHART SHOWING RELATION OF LENGTH OF TUBE TO COLLAPSING PRESSURE.

A study of the curves M and N taken in connection with the photographs of the experimental tubes after collapse and the figures showing lengths of collapsed portions will show, conclusively, that for lengths greater than about six diameters the strength of the tube when subjected to a fluid collapsing pressure is substantially constant. While studying the photographs and the values referred to, it must be kept in mind that the inability to stop the hydraulic pressure pump the instant the tube failed, together with the recoil of the hydraulic test cylinder, will account for an extension of the length of the collapsed portion by probably two or more diameters, after failure had actually occurred.

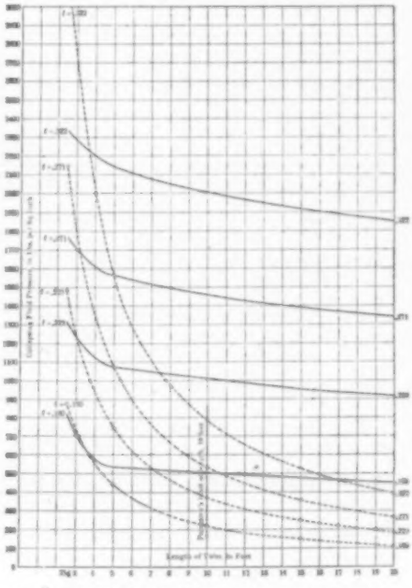


FIG. 8.—COMPARISON OF COLLAPSING PRESSURES OBTAINED FROM FAIRBAIRN'S FORMULAE AND THOSE OBRAINED IN STEWART'S TESTS.

Previously Published Formulae for the Collapsing Pressures of Tubes.

Since completing the present research, comparisons were made of the actual tests and the corresponding values calculated by the different published formulae. In these formulae—

P = probable fluid collapsing pressure in pounds, per square inch, as based upon the present research, and for the conditions stated.

p = collapsing pressure as calculated by the different published formulae for the same condition as for P.

d = outside diameter of tube, inches.

t = thickness of wall, inches.

l = length of tube, inches.

L = length of tube, feet.

$\frac{P}{p}$ *= the relation of actual collapsing pressure for any stated conditions, to that calculated by the different published formulae for the same conditions.*

Fairbairn's Empirical Formulae.

Fairbairn, from his experiments established the empirical formula:

$$p = 9{,}676{,}000\ \frac{t^{2.19}}{ld} = 806{,}300\ \frac{t^{2.19}}{Ld}$$

In Fig. 8, are plotted values obtained by means of this formula from the values in curve N, Fig. 7 as based on the tests in this research. The broken lines represent the values from the formula; the full lines are the same as curve N. For both sets of curves the thickness of wall in decimals of an inch is written at both ends of the curve representing the tube.

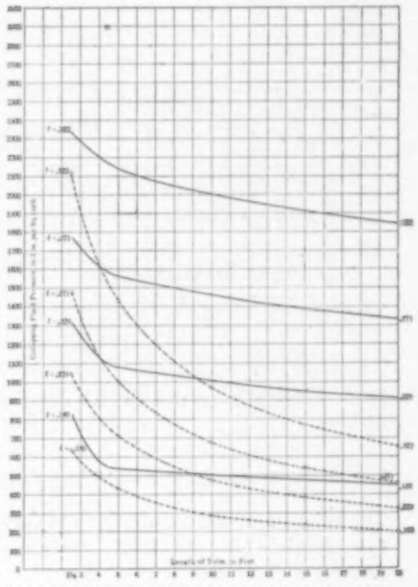


FIG. 9.—COMPARISON OF COLLAPSING PRESSURES OBTAINED FROM GRASHOF'S FORMULAE AND THOSE OBTAINED IN STEWART'S TESTS.

It would appear from this chart that Fairbairn's formula is applicable only to tubes having a comparatively thin wall, and, at the same time, a relatively short length between joints tending to hold the tube to a circular form. For 8⅝-inch commercial tubes, having thicker walls than 0.180 inch, it will be observed that Fairbairn's formula gives a correct collapsing pressure for one length, namely, that at which the broken line cuts the full line. The chart shows clearly that Fairbairn's formula

does not apply to modern lap-welded tubes having either relatively thick walls or long lengths between joints. Fairbairn developed an approximate formula from the preceding, in which

$$p = 9{,}676{,}000\,\frac{t^2}{ld} = 806{,}300\,\frac{t^2}{Ld}$$

This formula is also inapplicable to modern wrought tubes in relatively long lengths.

Wehage's formula for tubes with welded or butt joints according to Suplee's translation of Releaux's "Constructor" is:

$$p = 490{,}000\,\frac{t}{d}\,\sqrt[3]{\frac{t}{Ld}}$$

According to the German edition and *Dingler's Journal*, Vol. 242, p. 236, when corrected into English units this formula is:

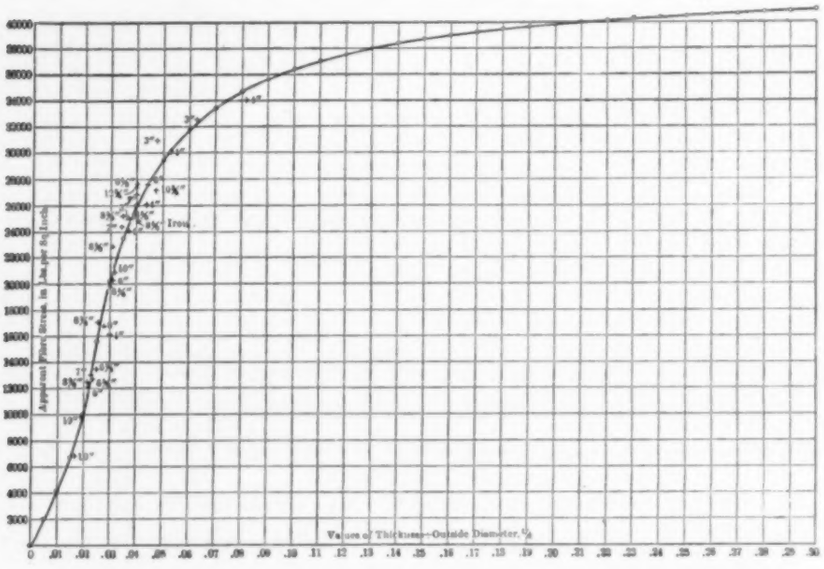


FIG. 10.—CHART SHOWING ACTUAL AND CALCULATED COLLAPSING PRESSURES PLOTTED TO THICKNESS DIVIDED BY DIAMETER.

Grashof's Formula.—Grashof deduced from Fairbairn's experiments the formula—

$$p = 24{,}480{,}000\,\frac{t^{2.215}}{ld^{1.278}} = 2{,}040{,}000\,\frac{t^{2.215}}{Ld^{1.278}}$$

The relation of the values derived from this formula to the true collapsing pressures is shown in Fig. 9.

Nystrom's Formula.—Nystrom derived from Fairbairn's experiments the formula—

$$p = 692{,}800\,\frac{t^2}{d\sqrt{l}}$$

Nystrom considered 4 a sufficient factor of safety for use with this formula.

Unwin's Formula.—Unwin's formula also derived from Fairbairn's experiments is—

$$p = 9{,}614{,}000\,\frac{t^{2.21}}{l^{0.9}d^{1.16}}$$

Other Formulae.—Clark derived a formula—

$$p = 200{,}000\,\frac{t^2}{d^{1.75}}$$

Love deduced a more complicated formula from Fairbairn's experiments,

$$p = 5{,}358{,}000\,\frac{t^2}{l\,d} + 41{,}900\,\frac{t^2}{d} + 1320\,\frac{}{}$$

Belpaire's formula, also deduced from Fairbairn's experiments reads:

$$p = 3{,}427{,}000\,\frac{t^2}{ld} + 56{,}890{,}000\,\frac{t^3}{ld^2}$$

$$p = 253{,}600\,\frac{t}{d}\,\sqrt[3]{\frac{t}{Ld}}$$

The English Board of Trade uses a formula which is obtained from Fairbairn's approximate formula, by using a factor of safety of about 9, and substituting $L + 1$ for L, namely,

$$p = \frac{90{,}000\,t^2}{(L+1)\,d}$$

All these formulae were plotted similarly to Fairbairn's formula, Fig. 8, and all show wide variations from the actual results.

Collapsing Tests, Series Two, on Twenty-Foot Lengths, Showing the Influence of Diameter and Thickness of Wall on the Collapsing Pressure.

The purpose of Series One was to determine the precise nature of the influence of length of tube upon the collapsing pressure. By length of tube is meant the distance between couplings, or other end connections, of a single length of tube, tending to hold it to a circular form. The experimental determinations constituting Series One, show, conclusively, that for commercial wrought tubes 8⅝ inches outside diameter, there is practically no difference in the collapsing pressure for lengths greater than six diameters up to 20 feet. As soon as this point was fully established experimentally, it was decided to make all succeeding tests on tubes in lengths of 20 feet. These tests were grouped as Series Two. The apparatus used, and the manner of making the tests were precisely the same as in series one.

Derivation of Formulae for the Probable Collapsing Pressure, Bessemer Steel Lap-Welded Tubes for Lengths of Twenty Feet.

The first step in the derivation of formulae was a regrouping of tests, according to the outside diameter of tube and the thickness of wall. It is apparent that for tubes subjected to external fluid pressure, there are three principal variables involved, the outside diameter, d, the thickness of wall, t, and the fluid-collapsing pressure, p. Each of these variables is a function of the other two. The variables, t and d were replaced by their quotient, $\frac{t}{d}$, which was then treated as a single variable. The results of all tests were then plotted to a vertical scale representing fluid-collapsing pressures in pounds per square inch, and a horizontal scale representing the quotient $\frac{t}{d}$, both expressed in inches. This plotting is shown in Fig. 10. By an inspection of this chart, it became apparent that all of the group averages could be represented by a straight-line formula, excepting a few in which $\frac{t}{d}$ was less than 0.023. On this basis, for values of $\frac{t}{d}$ greater than 0.023,

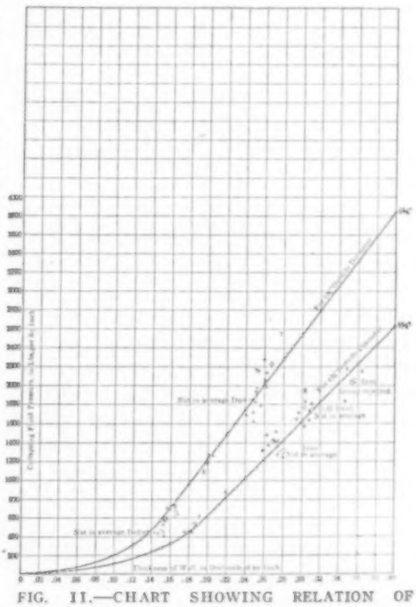


FIG. 11.—CHART SHOWING RELATION OF ACTUAL AND CALCULATED COLLAPSING PRESSURES TO THICKNESS OF WALL.

the following formula was deduced:

$$P = 85{,}670\,\frac{t}{d} - 1{,}386 \ldots\ldots (B)$$

It was not thought necessary to set

an upper limit to the value of $\frac{t}{d}$ in the application of this formula, as it was believed that it will give substantially correct results for all commercial lap-welded Bessemer steel tubes, in which $\frac{t}{d}$ is greater than 0.023.

The formula for values of $\frac{t}{d}$ less than 0.023, was derived on the assumption that when plotted on the chart, Fig. 10, the resulting curve would be tangent to the straight line representing formula B, and also tangent to the horizontal axis at the origin. This assumption gave a formula which represented very satisfactorily the few experiments in which $\frac{t}{d}$ was less than 0.023. The formula thus obtained is:

$$P = 1{,}600\left(1 - \sqrt{1 - 1600\,\frac{t^2}{d^2}}\right) \ldots\ldots (A)$$

This formula should be used for values of $\frac{t}{d}$ less than 0.023, and for P greater than $\frac{1}{12}\sqrt{d}$.

Since constructing the charts and tables, it was discovered that a formula having a rational form with empirical constants could be substituted for the empirical formula A. It is applicable only to tubes having relatively thin walls, that is, those having values of $\frac{t}{d}$ less than 0.023, and is:

$$P = 50{,}210{,}000\left(\frac{t}{d}\right)^3 \ldots\ldots (G)$$

The chart Fig. 11, shows a comparison of the results obtained by actual test with the corresponding calculated values, the values being calculated by means of formulae A and B, representing the most probable values for the collapsing pressures of tubes in lengths of 20 feet. The center of each small circle lying on these lines represents a plotted calculated value. The actual collapsing pressures of the different 85/8 inches, and by the mark (T) for tubes tested plotted to the same scales as the calculated values, are represented by crosses (+) for those having outside diameters of 3, 10, 4, 7 and 6 and 6 5/8 inches. The group averages are represented on the charts by means of combined crosses and circles.

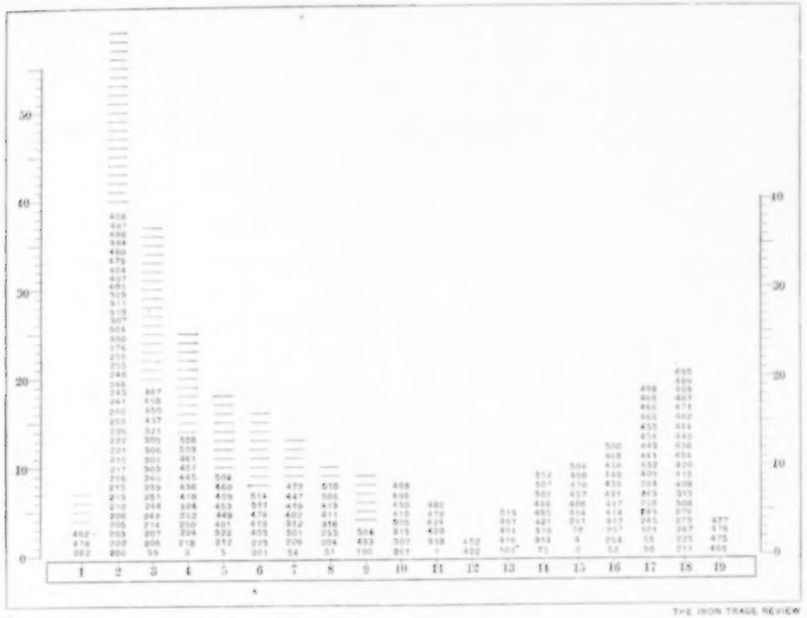


FIG. 12.—RELATION OF POINT OF COLLAPSE TO LENGTH OF TUBE.

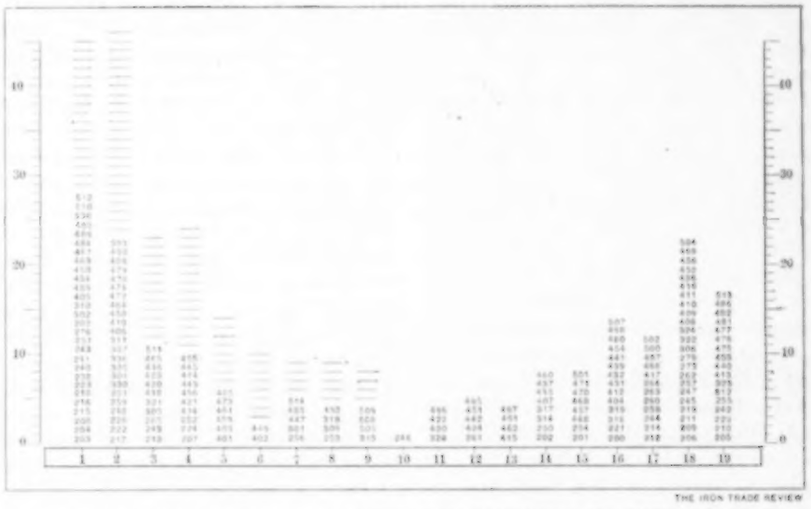


FIG. 13.—RELATION OF GREATEST DEPARTURE FROM ROUNDNESS TO LENGTH OF TUBE.

It will be observed that the group averages of the actual collapsing pressures lie very close to the corresponding values calculated by means of formulae A and B.

Apparent Fiber Stress on Wall of Tube at Instant of Collapse.

Fig. 10 shows the apparent compressive stress, in pounds per square inch at the instant of collapse on the walls of the tubes, constituting Series Two. The curve represents the formulae E and F, which were deduced to represent the most probable values of the apparent fiber stress in the walls of the tubes, constituting Series Two, at the instant of collapse, and are as follows:

For value of $\frac{t}{d}$ less than 0.023.

$$S = 500\,\frac{d}{t}\left(1 - \sqrt{1 - 1600\,\frac{t^2}{d^2}}\right) \ldots\ldots (E)$$

For values of $\frac{t}{d}$ greater than 0.023:

$$S = 43{,}335 - 693\,\frac{d}{t} \ldots\ldots (F)$$

in which S is the apparent fiber stress in pounds per square inch. An inspection of this chart shows that the apparent fiber stress on the wall of the tube at the instant of collapse varies from 7,000 pounds per square inch for the relatively thinnest to 35,000 pounds per square inch for the relatively thickest walls. This chart shows conclusively that the ability of a commercial wrought tube to withstand a fluid-collapsing pressure is not dependent alone upon either the ultimate strength or the elastic limit of the material constituting it.

Relation of Point of Collapse to Length of Tube.

Theoretically a tube should begin to collapse at the middle of its length, that is, at a point half way between the transverse joints or end connections. This statement is based upon the assumption that the material of the tube is perfectly homogeneous in its physical properties, and the diameter and thickness of wall are strictly constant throughout its entire length. In commercial tubes, however, the material is not strictly homogeneous in its physical properties, and there is also a slight variation in out-of-roundness of the different cross sections from end to end, as well as a percept-

TABLE I.

Thickness of wall inches.	2" O. D.		2¼" O. D.		2½" O. D.		2¾" O. D.		3" O. D.		3¼" O. D.		3½" O. D.		3¾" O. D.		4" O. D.		4¼" O. D.		4½" O. D.		4¾" O. D.	
	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.
0.10	2.03	2947	2.30	2466	2.56	2081	2.83	1766	3.10	1503	3.36	1281	3.63	1090	3.90	925	4.17	781	4.43	653	4.70	542	4.97	461
0.11	2.22	3381	2.51	2851	2.81	2427	3.10	2081	3.40	1792	3.69	1547	3.98	1338	4.28	1156	4.57	997	4.86	857	5.16	733	5.47	621
0.12	2.41	3814	2.73	3236	3.05	2774	3.37	2396	3.69	2081	4.01	1814	4.33	1586	4.65	1387	4.97	1214	5.29	1061	5.61	925	5.93	804
0.13	2.60	4248	2.94	3622	3.29	3121	3.64	2711	3.98	2370	4.33	2081	4.68	1833	5.03	1619	5.37	1431	5.72	1265	6.07	1118	6.41	986
0.14	2.78	4681	3.15	4007	3.53	3468	3.90	3026	4.28	2659	4.65	2347	5.02	2081	5.40	1850	5.77	1647	6.15	1469	6.52	1310	6.89	1168
0.15	2.96	5114	3.36	4392	3.76	3814	4.17	3341	4.57	2947	4.97	2614	5.37	2328	5.77	2081	6.17	1864	6.57	1673	6.97	1503	7.37	1351
0.16	3.14	5548	3.57	4777	4.00	4161	4.43	3657	4.85	3236	5.28	2881	5.71	2576	6.13	2312	6.56	2081	6.99	1877	7.42	1696	7.84	1533
0.17	3.32	5981	3.78	5162	4.23	4508	4.68	3972	5.14	3525	5.59	3148	6.05	2824	6.50	2543	6.95	2297	7.41	2081	7.86	1888	8.32	1716
0.18	3.50	6414	3.98	5548	4.46	4854	4.94	4287	5.42	3814	5.90	3414	6.38	3071	6.86	2774	7.34	2514	7.82	2285	8.30	2081	8.79	1898
0.19	3.67	6848	4.18	5933	4.69	5201	5.19	4602	5.70	4103	6.21	3681	6.72	3319	7.22	3005	7.73	2731	8.24	2489	8.75	2273	9.25	2081
0.20	3.84	7281	4.38	6318	4.91	5548	5.45	4917	5.98	4392	6.51	3948	7.05	3567	7.58	3236	8.12	2947	8.65	2693	9.18	2466	9.72	2263
0.21	4.01	7714	4.58	6703	5.14	5894	5.70	5232	6.26	4681	6.82	4214	7.38	3814	7.94	3468	8.50	3164	9.06	2897	9.62	2659	10.18	2446
0.22	4.18	8148	4.77	7088	5.36	6241	5.94	5548	6.53	4970	7.12	4481	7.71	4062	8.29	3699	8.88	3381	9.47	3100	10.06	2851	10.64	2628
0.23	4.35	8581	4.96	7474	5.58	6588	6.19	5863	6.80	5259	7.42	4748	8.03	4309	8.65	3930	9.26	3598	9.87	3304	10.49	3044	11.10	2811
0.24	4.51	9014	5.15	7859	5.79	6934	6.43	6178	7.07	5548	7.72	5014	8.36	4557	9.00	4161	9.64	3814	10.28	3508	10.92	3236	11.56	2993
0.25	4.67	9448	5.34	8244	6.01	7281	6.68	6493	7.34	5836	8.01	5281	8.68	4805	9.35	4392	10.01	4031	10.68	3712	11.35	3429	12.02	3176
0.26	4.83	9881	5.53	8629	6.22	7628	6.91	6808	7.61	6125	8.30	5548	9.00	5052	9.69	4623	10.39	4248	11.08	3916	11.77	3622	12.47	3358
0.27			5.71	9014	6.43	7974	7.15	7123	7.87	6414	8.59	5814	9.31	5300	10.04	4854	10.76	4464	11.48	4120	12.20	3814	12.92	3541
0.28			5.89	9400	6.64	8321	7.39	7439	8.13	6703	8.88	6081	9.63	5548	10.38	5085	11.12	4681	11.87	4324	12.62	4007	13.37	3723
0.29			6.07	9785	6.84	8668	7.62	7754	8.39	6992	9.17	6348	9.94	5795	10.72	5316	11.49	4898	12.27	4528	13.04	4199	13.81	3905
0.30					7.05	9014	7.85	8069	8.65	7281	9.45	6614	10.25	6043	11.05	5548	11.85	5114	12.66	4732	13.46	4392	14.26	4088
0.31					7.25	9361	8.08	8384	8.91	7570	9.73	6881	10.56	6290	11.39	5779	12.22	5331	13.04	4936	13.87	4585	14.70	4270
0.32					7.45	9708	8.30	8699	9.16	7859	10.01	7148	10.87	6538	11.72	6010	12.58	5548	13.43	5140	14.29	4777	15.14	4453
0.33							8.53	9014	9.41	8148	10.29	7414	11.17	6786	12.05	6241	12.93	5764	13.82	5344	14.70	4970	15.58	4635
0.34							8.75	9330	9.66	8437	10.57	7681	11.47	7033	12.38	6472	13.29	5981	14.20	5548	15.11	5162	16.01	4818
0.35							8.97	9645	9.91	8725	10.84	7948	11.77	7281	12.71	6703	13.64	6198	14.58	5752	15.51	5355	16.45	5000
0.36									10.87	9881	11.91	9014	12.07	7529	13.03	6934	14.00	6414	14.96	5955	15.92	5548	16.88	5183
0.37									10.39	9303	11.38	8481	12.37	7776	13.36	7165	14.34	6631	15.33	6159	16.32	5740	17.31	5365
0.38									10.63	9592	11.65	8748	12.66	8024	13.68	7397	14.69	6848	15.71	6363	16.72	5933	17.74	5548
0.39									10.87	9881	11.91	9014	12.95	8272	14.00	7268	15.04	7064	16.08	6567	17.12	6125	18.16	5730
0.40											12.18	9281	13.24	8519	14.31	7859	15.38	7281	16.45	6771	17.52	6318	18.58	5913
0.41											12.44	9548	13.53	8767	14.63	8090	15.72	7498	16.81	6975	17.91	6511	19.00	6095
0.42											12.69	9814	13.82	9014	14.94	8321	16.06	7714	17.18	7179	18.30	6703	19.42	6277
0.43													14.10	9262	15.25	8552	16.40	7931	17.54	7383	18.69	6896	19.84	6460
0.44													14.38	9510	15.55	8783	16.73	8148	17.90	7587	19.08	7088	20.25	6642
0.45													14.66	9757	15.86	9014	17.06	8364	18.26	7791	19.46	7281	20.67	6825
0.46															16.16	9246	17.39	8581	18.62	7995	19.85	7474	21.08	7007
0.47															16.46	9477	17.72	8798	18.97	8199	20.23	7666	21.48	7190
0.48															16.76	9708	18.05	9014	19.33	8403	20.61	7859	21.89	7372
0.49															17.06	9939	18.37	9231	19.68	8607	20.99	8051	22.29	7555
0.50																	18.69	9448	20.03	8810	21.36	8244	22.70	7737

ible variation in the thickness of wall. Because of these, a commercial tube is not necessarily weakest against collapsing pressure at the middle point of its length, as is the case for the theoretically perfect tube. The actual relation of the point of collapse to the length of tube, for the several hundred tubes tested, is shown in Fig. 12, which represents a 20-foot tube divided into foot lengths and numbered consecutively, beginning at the left-hand end. Over each division is placed the log number of the experimental tubes that collapsed at points nearest to that division. It will be observed that the greater number of tubes collapsed at points that are at distances of two feet and 18 feet from the left-hand end, that is, at a distance of two feet from either end. Comparatively few collapsed at or near the middle of their lengths. In order to have this chart show the relation of the point of collapse to the nearest end of the tube, it is obvious that the test numbers of the right-hand half should be transferred to the corresponding columns of the left-hand half; for example, test numbers over division 18, which is two feet from the right-hand end should be transferred to the column over division 2. This has been done for all the columns of the right-hand half of the chart, the dashes shown being made to represent the test numbers of the right-hand half of the scale transferred to the corresponding columns of the left-hand half. As the tubes were obtained in the usual commercial way and handled several times before being placed in the cylinder, it is not known in which direction any of the tubes were passed through the mill. Consequently, no significance can be attached to the fact that a greater number of tubes failed nearer the left than the right-hand end. The reason why the bulk of these tubes collapsed near one end is evidently due chiefly to the following two facts: (1), that a tube subjected to collapsing pressure is weakest where the departure from roundness is greatest, and (2), that the greatest departure from roundness for the bulk of these tubes was near one end, as shown in Fig. 13.

Relation of Axis of Collapse to Smallest Diameter.

The autographic calipering diagrams taken from the tubes show that none of them were exactly round. The departure from roundness was very small, varying all the way from zero to as much as possibly two per cent of the diameter. It is apparent that for homogeneous material and uniform thickness of wall, a tube of non-circular cross-section will yield in the direction of its smallest diameter, and the axis of collapse will be coincident with the original smallest diameter at the place of collapse. Slight out-of-roundness of the tubes tested was the chief factor in determining the place of collapse. The angular distance from the weld to the axis of collapse is quite uniformly distributed over about two-thirds of the possible distribution. The weld in itself is not an element of weakness for the tubes that are subjected to external fluid pressure.

The Relation of the Axis of Collapse to the Thinnest Portion of Wall.

It is concluded that the tendency of commercial tubes is to fail so as to have the axis of collapse at right angles to the diameter through the thinnest portion of the tube. It should be observed in this connection that the bending action on the wall of a tube while being collapsed is most pronounced at this point, that is to say, at 90 degrees from the axis of collapse. It will also appear that for commercial lap-welded tubes, the usual departure from roundness has a more pronounced effect in determining the manner of collapse. When these two influences are so related as to oppose each other, the latter almost invariably predominates.

Application to Practice of Stewart's Formulae A and B For Collapsing Pressures of Lap-Welded Steel Tubes.

Table of Collapsing Pressures and Weights.—The probable collapsing pressures contained in table I were calculated by means of the formulae A and B. They are substantially correct for any length greater than about six diameters of tube between transverse joints or end connections tending to hold the tube to a circular form. In the columns headed "C. P." are en-

TABLE I.

Thickness of wall inches.	5" O. D.		5¼" O. D.		5½" O. D.		6" O. D.		6⅝" O. D.		7" O. D.		7⅝" O. D.		8" O. D.		8⅝" O. D.		9" O. D.		10" O. D.		11" O. D.	
	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.	Wt.	C. P.
0.10																								
0.11	5.74	525	6.04	454	6.33	400																		
0.12	6.25	694	6.57	595	6.90	512	7.54	400	8.34	311														
0.13	6.76	867	7.11	760	7.46	663	8.15	501	9.02	380	9.54	331	10.41	269	10.93	240								
0.14	7.27	1041	7.64	925	8.01	820	8.76	636	9.70	466	10.26	400	11.19	321	11.75	286	12.69	239	13.25	217				
0.15	7.77	1214	8.17	1090	8.57	978	9.37	781	10.37	576	10.97	485	11.98	383	12.58	339	13.58	282	14.18	255	15.78	200		
0.16	8.27	1387	8.70	1255	9.13	1135	9.98	925	11.05	707	11.69	595	12.76	456	13.40	400	14.47	330	15.11	297	16.81	232	18.52	187
0.17	8.77	1561	9.22	1420	9.68	1293	10.59	1070	11.72	838	12.40	719	13.54	548	14.22	473	15.35	385	16.03	345	17.85	267	19.66	214
0.18	9.27	1734	9.75	1586	10.23	1450	11.19	1214	12.39	969	13.11	843	14.31	660	15.03	564	16.23	449	16.96	400	18.88	306	20.80	244
0.19	9.76	1907	10.27	1751	10.78	1608	11.79	1359	13.06	1100	13.82	966	15.09	774	15.85	672	17.12	527	17.88	464	19.91	350	21.94	277
0.20	10.25	2081	10.79	1916	11.32	1766	12.39	1503	13.72	1230	14.53	1090	15.86	887	16.66	781	18.00	624	18.80	542	20.93	400	23.07	314
0.21	10.74	2254	11.30	2081	11.86	1923	12.99	1647	14.39	1361	15.23	1214	16.63	1001	17.47	889	18.87	724	19.71	636	21.96	457	24.20	354
0.22	11.23	2427	11.82	2246	12.41	2081	13.58	1792	15.05	1492	15.93	1338	17.40	1115	18.28	997	19.75	825	20.63	733	22.98	525	25.33	400
0.23	11.72	2601	12.33	2411	12.95	2238	14.17	1936	15.71	1623	16.63	1462	18.17	1228	19.09	1106	20.62	925	21.54	829	24.00	607	26.46	452
0.24	12.20	2774	12.84	2576	13.48	2396	14.76	2081	16.37	1754	17.33	1586	18.93	1342	19.89	1214	21.49	1026	22.45	925	25.02	694	27.58	512
0.25	12.68	2947	13.35	2741	14.02	2554	15.35	2225	17.02	1885	18.02	1709	19.69	1456	20.69	1322	22.36	1126	23.36	1022	26.03	781	28.70	584
0.26	13.16	3121	13.86	2906	14.55	2711	15.94	2370	17.67	2015	18.72	1833	20.45	1569	21.49	1431	23.23	1227	24.27	1118	27.05	867	29.82	663
0.27	13.64	3294	14.36	3071	15.08	2869	16.52	2514	18.33	2146	19.41	1957	21.21	1683	22.29	1539	24.09	1327	25.17	1214	28.06	954	30.94	741
0.28	14.11	3468	14.86	3236	15.61	3026	17.11	2659	18.97	2277	20.10	2081	21.96	1797	23.09	1647	24.96	1428	26.08	1310	29.07	1041	32.06	820
0.29	14.59	3641	15.36	3401	16.14	3184	17.69	2803	19.62	2408	20.78	2205	22.72	1910	23.88	1756	25.82	1528	26.98	1407	30.07	1127	33.17	899
0.30	15.06	3814	15.86	3567	16.66	3341	18.26	2949	20.27	2539	21.47	2328	23.47	2024	24.67	1864	26.67	1629	27.88	1503	31.08	1214	34.28	978
0.31	15.53	3988	16.36	3732	17.18	3499	18.84	3092	20.91	2670	22.15	2452	24.22	2138	25.46	1972	27.53	1729	28.77	1599	32.08	1301	35.39	1057
0.32	15.99	4161	16.85	3897	17.70	3657	19.41	3236	21.55	2800	22.83	2576	24.97	2251	26.25	2081	28.38	1830	29.67	1696	33.08	1387	36.50	1135
0.33	16.46	4334	17.34	4062	18.22	3814	19.98	3381	22.19	2931	23.51	2700	25.71	2365	27.03	2189	29.24	1930	30.56	1792	34.08	1474	37.61	1214
0.34	16.92	4508	17.83	4227	18.74	3972	20.55	3525	22.82	3062	24.18	2824	26.45	2479	27.82	2297	30.08	2031	31.45	1888	35.08	1561	38.71	1293
0.35	17.38	4681	18.32	4392	19.25	4129	21.12	3670	23.46	3193	24.86	2947	27.19	2592	28.60	2406	30.93	2131	32.33	1985	36.07	1647	39.81	1372
0.36	17.84	4854	18.80	4557	19.76	4287	21.68	3814	24.09	3324	25.53	3071	27.93	2706	29.37	2514	31.78	2232	33.22	2081	37.06	1734	40.91	1450
0.37	18.30	5028	19.28	4722	20.27	4445	22.25	3959	24.72	3454	26.20	3195	28.67	2820	30.15	2622	32.62	2332	34.10	2177	38.05	1821	42.01	1529
0.38	18.75	5201	19.76	4887	20.78	4602	22.81	4103	25.35	3585	26.87	3319	29.40	2933	30.93	2731	33.46	2433	34.98	2273	39.04	1907	43.10	1608
0.39	19.20	5374	20.24	5052	21.28	4760	23.37	4248	25.97	3716	27.53	3443	30.14	3047	31.70	2839	34.30	2533	35.86	2370	40.03	1994	44.19	1687
0.40	19.65	5548	20.72	5217	21.79	4917	23.92	4392	26.59	3847	28.20	3567	30.87	3161	32.47	2947	35.14	2633	36.74	2466	41.01	2081	45.28	1766
0.41	20.10	5721	21.19	5383	22.29	5075	24.48	4536	27.21	3978	28.86	3690	31.59	3274	33.24	3056	35.97	2734	37.61	2562	41.99	2167	46.37	1844
0.42	20.54	5894	21.67	5548	22.79	5232	25.03	4681	27.83	4109	29.52	3814	32.32	3388	34.00	3164	36 80	2834	38.49	2659	42.97	2254	47.46	1923
0.43	20.99	6068	22.14	5113	23.28	5390	25.58	4825	28.45	4239	30.17	3938	33.04	3502	34.76	3273	37.64	2935	39.36	2755	43.95	2341	48.54	2002
0.44	21.43	6241	22.60	5878	23.78	5548	26.13	4970	29.06	4370	30.83	4062	33.76	3615	35.53	3381	38.46	3035	40.23	2851	44.93	2427	49.62	2081
0.45	21.87	6414	23.07	6043	24.27	5705	26.67	5114	29.68	4501	31.48	4186	34.48	3729	36.29	3489	39.29	3136	41.09	2947	45.90	2514	50.70	2160
0.46	22.30	6588	23.53	6208	24.76	5863	27.22	5259	30.29	4632	32.13	4309	35.20	3843	37.04	3598	40.11	3236	41.96	3044	46.87	2601	51.78	2238
0.47	22.74	6761	23.99	6373	25.25	6020	27.76	5403	30.90	4763	32.78	4433	35.92	3956	37.80	3706	40.94	3337	42.82	3140	47.84	2687	52.86	2317
0.48	23.17	6934	24.45	6538	25.73	6178	28.30	5548	31.50	4893	33.42	4557	36.63	4070	38.55	3814	41.76	3437	43.68	3236	48.80	2774	53.93	2396
0.49	23.60	7108	24.91	6703	26.22	6336	28.84	5692	32.11	5024	34.07	4681	37.34	4184	39.30	3923	42.57	3538	44.54	3333	49.77	2861	55.00	2475
0.50	24.03	7281	25.37	6868	26.70	6493	29.37	5837	32.71	5155	34.71	4805	38.05	4297	40.05	4031	43.39	3638	45.39	3429	50.73	2947	56.07	2554

tered the probable collapsing-fluid pressures in pounds per square inch; while in columns headed "Wt" are entered the plain-end weights in pounds per foot length. It will be noted that each weight column and the corresponding collapsing pressure taken together constitute a double column that is headed by the outside diameter of the tube to which the double column corresponds.

Example 1. Find the plain-end weight and the probable collapsing pressure of a lap-welded steel tube whose outside diameter is six inches and thickness of wall 0.190 inch.

In double column headed "6 O. D.," Table 1, and opposite 0.18 in the extreme left-hand column read 11.19 and 1214, the first being the required plain-end weight in pounds per foot length and the second the probable collapsing-fluid pressure in pounds per square inch. This collapsing pressure is for a 20-foot length between transverse joints or other supports tending to hold the tube to a circular form, but is also substantially correct for any length greater than about six diameters or, in this case, three feet.

Example 2. Find the collapsing pressure of a tube seven inches outside diameter having a plain-end weight of 17 pounds per foot.

From the double column head "7 O. D.," Table 1, we find that a plain-end weight of 17.33 pounds per square foot corresponds to a probable collapsing pressure of 1,586 pounds per square inch, and also that a weight of 16.63 pounds corresponds to a collapsing pressure of 1,462 pounds. Now, by the usual method for interpolating it will be found that for a plain-end weight of 17 pounds per foot the corresponding collapsing pressure will be 1,527 pounds per square inch.

It is believed, however, that the tabular values in this table are sufficiently numerous to render it unnecessary to make any interpolations whatever while applying it to practice.

Factors of Safety.—It must be remembered that these tabular values represent the probable collapsing pressures as based upon the tests. This being the case, any individual tube is as likely to fail above as below this most probable pressure. The relation of the collapsing pressures of the individual tubes to the most probable, is such that not one of the several hundred tubes tested failed at a pressure lower than 42 per cent of the collapsing pressure, while ½ of one per cent of the number of tubes failed at 37 per cent and two per cent at 25 per cent of that pressure. In other words, with an actual factor of safety of 1.75, as based upon this table, not one of the tubes tested would have failed.

It would appear, therefore, that, for the most favorable practical conditions, namely, when the tube is subjected only to stress due to fluid pressure and only the most trivial loss could result from its failure, a factor of safety of three would appear sufficient. When only a moderate amount of loss could result from failure a factor of safety of four should be used. When considerable damage to property and loss of life might result from a failure of the tube, a factor of safety of six should be used. When the conditions of service are such as to cause the tube to be less capable of resisting collapsing pressure, such as the thinning of wall due to corrosion, the weakening of the material due to over-heating, the creating of internal stress in the wall of the tube due to unequal heating, vibration, etc., the above factors of safety should be increased in proportion to the severity of these actions.

Linear Units for d and t.—It should be noted that both the outside diameter *d*, and thickness of wall *t*, must be expressed in the same linear unit of measure, as, for example, in inches, centimeters, millimeters, etc. The name of the unit is immaterial, the formula being just as applicable to obtaining probable collapsing pressures in pounds per square inch when the diameter and thickness are expressed in metric as when in English units. The resulting pressure in pounds per square inch may be converted to kilograms per square centimeter by multiplying by the factor 0.0703.

Stocks Steady with the Market Quiet.

The stock market of the past week recovered to some extent from the inactivity recently manifested and transactions were fairly large. Trading, however, was almost entirely in the hands of professional operators and was restricted to a narrow range of issues, as a result of which the 1,000,000 share mark was not reached. The early days of the week developed the greatest activity and considerable strength was manifested through the successful resumption of operations by San Francisco banks and the favorable nature of crop reports. Money conditions were easy and the foreign situation was entirely satisfactory. Later in the week, however, a sagging tendency developed largely as a result of the packing house exposures. This industry ranks second in size only to the iron and steel industry and the effect of recent disclosures upon the export trade is certain to be extensive. Indirectly, this will work a hardship to the railroads through decreased shipments and will cut down our foreign credits, making it more difficult to import gold. Effects of the San Francisco earthquake are still being felt, a striking instance being the recent reduction by a London fire insurance company from 14 to nine per cent in its dividend rate. The total fire loss is not expected to fall much, if any, below $300,000,000. In spite of these depressing influences, however, industrial stocks in the main held firm during the week and changes were for the most part fractional. American Ship Building made a sharp advance chiefly by virtue of heavy bookings for 1907 business, though rumors of a re-organization were also rife. The Steel Corporation stocks were fairly active. Other iron and steel securities were comparatively dull.

Recent dividend declarations include the following: J. G. White & Co., regular quarterly, 1½ per cent on preferred, payable July 2; General Electric Co., regular quarterly two per cent, payable July 16; American Car & Foundry Co., regular quarterly 1¾ per cent on preferred, payable July 2; American Can Co., regularly quarterly 1¼ per cent on preferred, payable July 2.

Directors of the American Steel Foundries at a recent meeting received the report of a committee recommending the retirement of the common and preferred stock held in the treasury. It is understood that this consists of about $2,000,000 common and $500,000 preferred. This action eliminates the possibility of this stock going on the market, as the Steel Foundries is well supplied with cash and does not require additional funds from the sale of securities.

THE LEADING INDUSTRIAL SECURITIES.

	Closing Quo. June 4	Closing Quotation June 11	Changes	Date of 1906 Ann. Meet.	Par Value	Capital Outstanding	Dividend Basis	Dividend Being Paid	Dividend Date Last Div. Dec.
Allis-Chalmers Co	23⅜	22⅛	— ⅞	Sept.	100	19,820,000		.....	.....
Allis-Chalmers preferred	60¾	58⅛	—2⅝		100	16,150,000	7 cum	.....	Feb., 1904
American Can	7½	7½	.....	Apr. 24	100	41,233,300		.....	.....
American Can preferred	61½	62	+ ½		100	41,233,300	7 cum	5 Q.	July, 1906
American Car and Foundry	41¾	41½	+ ¼	June 28	100	30,000,000		.....	May, 1905
AmericanCar and Foundry preferred	102	102¼	+ ¼		100	30,000,000	7 n. c.	7 Q.	July, 1906
American Locomotive	70¾	70⅝	+ ⅛	Oct. 16	100	25,000,000		.....	.....
American Locomotive preferred	114	115⅛	+1⅛		100	24,100,000	7 cum	7 Q.	Apr. 1906
American Shipbuilding	57	64	+7	Oct. 2	100	7,600,000	4	4 Q.	Apr., 1906
American Shipbuilding preferred	105	106	+1		100	7,900,000	7 n. c.	7 Q.	Jan., 1906
American Steel Foundries	12¾	12	— ¾	Oct. 3	100	17,700,000		.....	.....
American Steel Foundries preferred	49	46⅛	—2⅞		100	17,700,000	6 cum	.....	Aug., 1905
Barney & Smith	65	65	.....	June 5	100	1,000,000		.....	June, 1894
Barney & Smith preferred	140	140	.....		100	2,500,000	8 cum	8 Q.	Mch. 1906
Bethlehem Steel	30	31¾	+1¾	April 3	100	15,000,000		.....	.....
Bethlehem Steel preferred	88⅜	88½	+ ⅛		100	15,000,000	7 n. c.	7 Q.	May, 1906
Bullock Electric preferred	111	111	.....	Oct. 2	100	1,000,000	6	6 Q.	July, 1906
Cambria Steel	34¾	35¾	+1	March 20	50	45,000,000	6	7 Q.	Mar., 1906
Cambria Iron	49½	49½	.....		50	8,468,000	4	4 S. A.	Apr., 1906
Colorado Fuel & Iron	50⅞	50⅛	—¾	Oct. 15	100	30,132,000	7	.....	Apr., 1902
Wm. Cramp & Sons Ship & Eng. Bldg. Co.	22	22	.....	May 31	100	6,098,000	5	.....	Nov., 1902
Crucible Steel	13¾	15⅛	+ ¼	Oct. 17	100	25,000,000		.....	.....
Crucible Steel preferred	80	80	.....		100	25,000,000	7 cum	.....	Sept. 1903
Empire Steel	5	5	.....	Feb. 28	100	2,281,400		.....	.....
Empire Steel preferred	36	36	.....		100	2,500,000	6 cum	3 S. A.	Jan., 1905
Fay & Egan	93½	93½	.....	Feb. 20	100	1,000,000	5	5 Q.	Nov., 1905
Fay & Egan preferred	128½	128½	.....		100	1,000,000	7 cum	7 Q.	Nov., 1905
General Electric	169¼	172	+2¾	May 8	100	48,256,050	8	8 Q.	July, 1906
International Pump	54	54	.....	June 5	100	12,262,500		2	July, 1905
International Pump preferred	87	88¾	+1¾		100	8,850,000	6 cum	6 Q.	May, 1906
Lackawanna Steel	71	71	.....	March 14	100	34,971,400		.....	.....
Lake Superior Corporation	20¾	20	— ¾	Oct. 3	100	40,000,000		.....	.....
Niles-Bement-Pond	130	130	.....	Feb. 7	100	5,000,000	6	6 Q.	May, 1906
Niles-Bement-Pond preferred	105	105	.....		100	2,000,000	6 cum	6 Q.	Mch., 1906
Otis Elevator Co	59	49	—10	March 19	100	6,350,300		2 A.	Apr., 1906
Otis Elevator Co. preferred	105	98	—7		100	5,589,500	6 n. c.	6 Q.	Apr., 1905
Pittsburg Coal Co	13⅜	13⅝	+ ⅜	Feb. 12	100	30,135,000		.....	.....
Pittsburg Coal preferred	54	54½	+ ½		100	30,716,200	7	.....	Apr., 1905
Pressed Steel Car	52	52¾	+ ¾	Feb. 21	100	12,500,000		3	Aug., 1904
Pressed Steel Car preferred	97½	98½	+1		100	12,500,000	7 n. c.	7 Q.	May, 1906
Pullman Palace Car	227	228	+1	Oct. 18	100	74,000,000		8 Q.	Feb., 1906
Railway Steel Spring	52¾	54⅞	+2⅛	March 1	100	13,500,000		4 S. A.	Oct., 1905
Railway Steel Spring preferred	102	101½	— ½		100	13,500 000	7 cum	7 Q.	June, 1906
Republic Iron & Steel	29	30	+1	Oct. 17	100	27,352,000		.....	.....
Republic Iron & Steel preferred	103½	105	+1½		100	20,852,000	7 cum	7 Q.	Apr., 1906
Sloss-Sheffield	80¼	79	—1¼	March 14	100	7,500,000	5	5	Jan., 1906
Sloss-Sheffield preferred	108	108	.....		100	6,700,000	7 n. c.	7 Q.	Jan., 1906
Tennessee Coal & Iron	156¾	155	—1¾	May 15	100	22,552,800		4 Q.	Apr., 1906
U. S. Cast Iron Pipe & Foundry	52⅛	51⅝	— ⅝	June 27	100	12,500,000		2	June, 1906
U. S. Cast Iron Pipe & Foundry preferred	93½	93	— ½		100	12,500,000	7 n. c.	7	June, 1906
U. S. Steel	41	40¾	— ¼	April 16	100	508,302,500		.....	Dec., 1903
U. S. Steel preferred	105⅞	106	+ ⅛		100	360,281,100	7 cum	7 Q.	May, 1906
U. S. Steel 5's	98½	99	+ ⅛		100	463,798,000	5	5 A.	
Virginia Iron, Coal & Coke	43	44	+ 1	Sept. 18	100	8,641,600		.....	.....
Westinghouse Electric	158	159	+ 1	June 27	50	20,996,350	10	10 Q.	Apr., 1906
Westinghouse Air Brake	148½	147	—1½	Oct. 2	50	10,990,450	20	20 Q.	Apr., 1906

NEWS FROM MANY INDUSTRIES.

New Buyers:—

The Kearney & Trecker Co., Milwaukee, Wis., has been incorporated with a capitalization of $100,000 to manufacture iron products. The incorporators are: Edward J. Kearney, Theodore Trecker and William Quarles.

The Clyde Machine Works Co., Chicago, Ill., has been organized with a capitalization of $100,000 by William Foster, Robert Foster and Edward J. Stevens.

The Calkins Stove Mfg. Co., Columbus, O., has been incorporated with a capital of $100,000 to manufacture stoves and ranges of all kinds. The incorporators are: William R. Calkins, William H. Calkins, Oscar H. Mithoff, George H. Harkenberg, Alvah A. Faine and William Reed.

The Curtis Wire Fence Tool Co., Dalhart, Dallam county, Tex., has been incorporated with a capital of $25,000 by Z. A. Curtis, C. P. Elliott and H. W. Eubank, of Channing, Hartley county; W. B. Slaughter, of Dalhart, and C. E. Oakes, of Amarillo.

The William C. Johnson & Sons Machinery Co., St. Louis, Mo., has been incorporated with a capital of $25,000 by William C. Johnson, Richard S. Johnson and Daniel S. M. Johnson.

The Bubb Air Brake Co., Kittanning, Pa., has been incorporated with a capital of $3,000,000 to manufacture, sell and deal in air compressors and brakes of all kinds and descriptions. The incorporators are: J. S. Bubb, Henry A. Colwell, Kittanning, Pa.; N. Burrows Bubb, Harry C. Bubb, Williamsport, Pa.; and William Belto, Pittsburg.

The Kuhner Engine & Machine Co., Rock Island, Ill., has been incorporated with a capital of $25,000 to manufacture machinery. The incorporators are: Frank G. Young, Harry E. Miller and Morris Heagy.

The Port Angeles Stove Co., Olympia, Wash., has been incorporated with a capitalization of $500,000 by Arthur J. Burroughs, Thomas Heath and C. T. Gloss.

The Iowa Machine Co., Clinton, Ia., has been incorporated with a capital of $15,000 by E. S. Reynolds, W. J. Keefe and J. F. McGinty.

The Dominion Henderson Bearings Ltd., Toronto, Ont., has been organized with a capital of $300,000 by William Bowman, John F. Adams, Christopher W. Thompson, John H. Whitehead H. C. Macdonald, William E. Wood, Ernest P. Seon, Joseph G. Gibson and Charles H. Hunter.

The Ontario Iron & Steel Co., Ltd., Toronto, Ont., has been organized with a capitalization of $500,000 by David Muhlfelder, Joseph Steefel and William L. German.

The North Range Nickel & Iron Mining Co., Ltd., Sudbury, Ont., has been organized with a capitalization of $1,000,000 by William J. Bell, Alexander B. Gordon and Joseph Morin.

The Refined Iron & Steel Co., capital $30,000, has been incorporated with J. C. DeNoon, president; I. M. DeNoon, treasurer; H. F. Gilg, secretary and William Stubblebine, general manager. Offices are in the Lewis block, Pittsburg. The company has bought the plant of the United States Wire & Nail Co., near Shoustown, Pa.

The Reading Steel Castings Co., Reading, Pa., has been incorporated with a capitalization of $125,000 by D. W. Yeckley and W. Conover, of New York, and S. J. Wheeler, of Roselle, N. J. A plant at Reading, formerly occupied by the Brylgon Steel Casting Co., will be put in shape to manufacture small castings. W. D. Sargent is president of the company and J. Turner Moore vice president and general manager. An office is maintained at 114 Liberty street, New York.

The Day Foundry Co. has been incorporated to conduct a general foundry business. The capital stock is $20,000, and the incorporators are: Reginald F. Day, William Smith and P. B. McNaughton, Buffalo, N. Y.

The Richmond Hill Foundry Co. has been incorporated with a capital stock of $12,000 to manufacture steel, iron and metal products, etc. The incorporators are: Ernest Haussler, 10 Cherry street, Brooklyn Hills, N. Y.; Thomas Rochester and Peter Belford, Richmond Hill, N. Y.

The Rothar & Slater Mfg. Co. has been granted a charter to manufacture and deal in asbestos, iron, steel, coal, coke, etc. The capital stock is $25,000, and the incorporators are: Joseph J. Slater, 129 Hopkinson avenue; Henry P. Rothar, 28 Shaffer street; and Michael J. Tanner, 506 Hamburg avenue, all of Brooklyn.

The Economy Piston Co. has been chartered to manufacture engines, machinery, tools, etc. The capital stock is $14,000, and the incorporators are: Albert R. Lee, 101 Wall street; Theodore L. Bailey and Ellicott D. Curtis, 55 Williams street, all of New York.

The Snowplow & Mfg. Co. has been incorporated to manufacture snow-fighting equipments. The capital stock is $50,000 and the officers are: President, William E. Wilder, 1 Brooks avenue, Worcester, Mass.; treasurer, Henry S. Wilder, 107 Park street, Newton, Mass.; clerk, George M. Faulkner, 71 Chestnut street, Cambridge, Mass.

The Manhattan Screw & Stamping Works, incorporated with a capital stock of $200,000 will manufacture and deal in brass, iron, steel and metal goods. The incorporators are: Samuel Wilner, Elias R. Wilner and Anna S. Wilner, all of the corner Seventh avenue and Eleventh street, New York.

New Construction:—

The Beaver Dam Malleable Iron Co., Beaver Dam, Wis., is erecting a building 90 x 300 feet to be used as a foundry, and another of the same size for annealing room, core room, etc. The construction work is practically finished, and the plant will start at an early date with about 100 new molders. This company has contracted to furnish the Chicago, Milwaukee & St. Paul railroad with castings for from 20 to 30 cars a day for the next five years. The new plant will be run in connection with the old.

The Crist Valve Mfg. Co., Chittenango, N. Y., has just erected an iron cupola and will make iron valves in addition to carrying on a general foundry business in the way of light castings.

The Direct Drive Axle Co., Columbus, O., has secured factory quarters and installed necessary machinery. It will soon place its output on the market. The axle which it manufactures entirely eliminates the transmission box, driving direct on the axle on all speeds, forward and reverse, without any frictional device or sliding gear for changing speeds.

The Troy Malleable Iron Works, Troy, N. Y., has let the contract for a new foundry building 75 x 375 feet. An addition 75 x 135 feet was recently made to the core room.

The Monarch Fence Co., Adrian, Mich., has purchased a site along the Lake Shore tracks, and is preparing plans for a factory building 85 x 125 feet. O. L. Palmer, formerly connected with the Lamb Fence Co., will be secretary and general manager of the new company.

The Kemmerer Iron & Steel Co., Scranton, Pa., which is erecting a new rolling mill building 120 x 265 feet, occupies a one-story building 49 x 154 feet and a three-story structure 53 x 91 feet. The company owns a tract of 22

acres with three railroad switches. Its output, which consists entirely of bars, is 20,000 tons annually.

The Arthur Koppel Co., of New York and Berlin, Germany, has received from Dodge & Day, engineers of Philadelphia, complete plans for its new works on which construction will begin at once. The plant, which will be located at Homewood, about 30 miles from Pittsburg, will include a section of the erecting shop, a light car shop, switch shop, service building, office building and a part of the power plant. H. A. Ellis, who will have charge of the construction, has opened an office at 1771 Frick building annex, Pittsburg.

General Industrial Notes:—

The Ingersoll-Sargeant Drill Co. was victorious in the recent decision in the Chancery division of the High Court of Justice, London, Eng., in the suit brought by the Consolidated Pneumatic Tool Co., Ltd., charging infringement of patents on the Boyer pneumatic hammer and seeking to enjoin the sale of Raeseler pneumatic hammers in Great Britain. Costs were adjudged against the plaintiff, which is the English branch of the Chicago Pneumatic Tool Co.

The report of the American Pig Iron Storage Warrant Co., 44 Wall street, New York, shows that stocks in yard during May decreased from 24,500 tons to 21,300 tons. Receipts were 500 tons and deliveries 3,700 tons.

The stack of the Star Furnace Co., Jackson, O., manufacturer of high silicon irons, is out of blast for relining.

The Northwestern Car & Locomotive Works, a new corporation, has purchased the Hegewisch shops, Hegewisch, near Chicago. C. H. Wilcox is president of the new company, and Alexander Huston, formerly with the Republic Iron & Steel Co., is vice president.

The Novelty Iron Works, Punxsutawney, Pa., manufacturer of mine cars and carrying on a general foundry business, has changed its name to the Punxsutawney Foundry & Machine Co.

The Newark Steel Plant, Newark, O., was recently sold at master commissioner's sale to J. W. Lee, Pittsburg, for $7,170.

The Parish-Alford Fence & Machine Co., Knightstown, Ind., has been reorganized and the controlling interest has been sold to A. H. Loeb, of Chicago, a member of the Sears-Roebuck Co., which will take the entire output of the plant.

The Craig-Reynolds Foundry Co., Dayton, O., is to dispose of its plant located in North Dayton, authority for the sale having been voted by the stockholders. A board of directors has been chosen as follows: H. N. Reynolds and George B. Smith, of Dayton, and William C. Proctor, Thomas B. Shipley and E. B. Emerson, of Cincinnati.

The Carter Iron Co., Pittsburg, which recently purchased the plant of the Ohio Valley Steel & Iron Co., at Paden City, W. Va., has leased a large block of gas territory near that place, and will develop it for gas for the operation of a steel plant.

Owing to a serious coke famine a number of smelting and foundry plants in northern Mexico have been forced to close temporarily. The growth of coke consuming industries is outstripped that of railroad transportation facilities.

The National Malleable Castings Co., Sharon, Pa., during May turned out 29,300 couplers, establishing a record. Arrangements are being made for enlarging the plant.

The Tennessee Coal, Iron & Railroad Co. estimates its probable production of open-hearth rails for 1907 at 350,000 tons. Improvements now contemplated will increase its capacity after that time to 50,000 tons per month.

The Atlanta Steel Hoop Co., Atlanta, Ga., has its new bloom mill, rail mill and cotton-tie plant in operation. The bloom mill has a capacity of 150 tons per day.

Fires:—

The Leonard Stove & Range Co., Bowling Green, O., was damaged to the extent of $25,000 by fire May 30, when the entire plant, with the exception of the brick molding room, was burned. A large quantity of new brass patterns was destroyed and the machinery loss was heavy.

The Foos Gas Engine Co., Springfield, O., lost its blacksmith shop by fire June 1. Damage is estimated at $1,000.

The Ferguson Radcliffe Co., Philadelphia, sustained the loss of its plant by fire May 29. The damage is estimated at $10,000.

The pattern shops of the East Buffalo Iron Works, Buffalo, N. Y., burned June 2, with a loss of $12,500. Molders in this establishment have been on strike for the past six weeks.

The plant of the Highland Machine Co., at Lombard and Tenth streets, Highlandtown, Md., was damaged by fire on May 28 to the extent of $4,000.

The building occupied by the Standard Roller Bearing Co., at Forty-eighth street and Merion avenue, Philadelphia, on June 1, suffered damage by fire of $2,000.

Trade Notes:—

The American Ship Building Co. during the week closed contracts for three more steel freighters, making 11 in addition to the D. & C. passenger steamer booked for 1907 delivery. Two of the freighters ordered are for the Gilchrist Transportation Co. They will be 520 feet over all with a carrying capacity of 9,500 tons, and will cost $370,000 each. The third contract was placed by Duluth interests and calls for a steamer 440 feet over all to cost $290,000.

Theodore Geissman & Co., Chicago, representing iron, steel and wire interests, have opened an office at 536 Andrus building, Minneapolis.

The Toledo Machine & Tool Co., Toledo, O., among other large orders recently closed a contract for a drop forge equipment, consisting of one each of a 10,000-pound, 8,000-pound, 3,000-pound, 2,000-pound, 1,600-pound, 1,500-pound, 1,100-pound and 1,000-pound trimming presses. This company will also furnish equipment for 27 direct connected motor-drive presses, ranging in size from 3,000 to 75,000 pounds.

The Western Maryland Railroad Co. has placed an order with the Pressed Steel Car Co. for 7,000 freight cars.

The Electric Cable Co. has received an order from the New York & Long Island Railroad Co. for six miles of 300,000 C. M. Voltax cable. This follows an order placed some months ago for 15 miles of cable.

The Crocker-Wheeler Co., Ampere, N. J., has received orders for three 130-kilowatt W., 250-volt gas engine driven generators for the Garford Co., Elyria, O., for a 100-kilowatt, 230-volt generator, and three motors of 35, 25 and 20 horsepower and two motors of ten horsepower, all of 230 volts for the Floyd, Wells Co., Ryersford, Pa.; and for two motors and generators for the Lehigh Portland Cement Co., Ormrod, Pa.

The Avery Stamping Co., Cleveland, O., has lately gone into the matter of furnishing pressed steel molders' ladles of various sizes, and is figuring on some large specifications at this time. Business is reported as very satisfactory. The company's die department has been overcrowded with shop specifications on special pressed steel work which until recently delayed shipments, and on the regular lines of shovels, etc., stocks have been replenished to take care of the trade. Exceptional success is reported with the company's patented plainback tubular socket and molders' shovels which have only recently been placed on the market.